

Air quality Impact Assessment

Appendix F



Appendix F — Air quality Impact Assessment

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Air Quality Impact Assessment Proposed Bourke Small Stock Abattoir

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Air Quality Impact Assessment

Proposed Bourke Small Stock Abattoir

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Executive Summary

SLR Consulting Australia Pty Ltd was commissioned by CAPRA Developments Pty Limited to perform a Construction and Operational Air Quality Impact Assessment (including odour) for the proposed development of a small stock abattoir located approximately 14 kilometres north of Bourke in north-western New South Wales.

This study will inform the overall Environmental Impact Statement required to be submitted to the NSW Department of Planning and Environment. The specific requirements of this study are clearly outlined within the Secretary's Environmental Assessment Requirements as issued for State Significant Development 7268 on 29 October 2015.

The objective of this air quality impact assessment was to define the sources of air emissions from the proposed construction and operation of the Project and assess their potential impacts against applicable air quality criteria to determine the requirement for further mitigation and control, and to identify any residual impacts.

The potential impacts on local air quality from construction activities were assessed qualitatively, using the *IAQM Guidance on the Assessment of Dust from Demolition and Construction* developed in the United Kingdom by the Institute of Air Quality Management.

The qualitative assessment of construction impacts considered, via a screening assessment, the likely dust emissions from the construction of the abattoir and associated infrastructure. Overall, the risk of air quality impacts due to fugitive dust emissions from earthworks, construction of infrastructure, and track-out of dust onto public roads were determined to be *negligible* across the Project Site given the distance between the Project site and the nearest sensitive receptors. Mitigation and management measures will still be applied during the works and therefore it is considered that there is no potential for adverse impact due to dust emissions generated during the construction phase of the Project.

The potential impacts on local air quality from operational activities were assessed quantitatively using regulatory-approved atmospheric dispersion modelling methodologies. The operational phase assessment addressed the potential impacts on local air quality of emissions of nitrogen dioxide (NO₂), particulate matter less than 10µm in diameter (PM₁₀), and odour from the operation of the proposed Bourke small stock abattoir. The pollutant emission rates and source parameters used in the modelling were based on a combination of site-specific information and data from air quality assessments carried out for similar facilities.

The ground level pollutant concentrations predicted at the nearest sensitive receptors met their respective guidelines for the appropriate averaging periods, with and without the inclusion of background air quality concentrations. Provided the abattoir is well managed, it is therefore concluded from these results that it will be able to operate in compliance with all relevant ambient air quality standards.

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1 INTRODUCTION

SLR Consulting Australia Pty Ltd (SLR) was commissioned by CAPRA Developments Pty Ltd (CAPRA) to perform a Construction and Operational Air Quality Impact Assessment (AQIA) (including odour) for the proposed development of a small stock abattoir (herein referred to as the Project). The Project site is located approximately 14 kilometres (km) north of Bourke in the Far West region of New South Wales (NSW). The abattoir is proposed to have the capacity to process up to 6,000 head per day, consisting of sheep, lambs and goats.

CAPRA intends to seek development consent under Division 4.1 of Part 4 of the NSW *Environmental Planning and Assessment Act* (1979) (EP&A Act) to allow the construction and operation of a small stock abattoir within the Project site. This study will inform the overall Environmental Impact Statement (EIS) required to be submitted with the Project Application to the NSW Department of Planning and Environment (DP&E). The specific requirements of this study are outlined within the Secretary's Environmental Assessment Requirements (SEAR's) as issued for State Significant Development 7268 29 October 2015, and reproduced in **Section 1.1**.

1.1 Secretary's Environmental Assessment Requirements for State Significant Development 7268

The SEAR's for the Project as they relate to air quality and odour are presented in **Table 1**. A description of how these requirements have been met is presented in **Section 1.2**.

Table 1 Key Assessment Requirements

Key Issue/Assessment Requirement	Where Addressed in this Report
Department of Planning and Environment (Secretary's Requirements)	
Air Quality and Odour – including:	
An assessment of all potential air quality and odour sources from construction and operation of the abattoir and its wastewater treatment system, including details of air quality and odour impacts on private properties, in accordance with the relevant guidelines;	Construction – Section 6 Operation – Section 7
details of mitigation, management and monitoring measures for preventing and/or minimising both point and fugitive emissions; and	Project Description – Section 2.2 Emission Estimation – Section 7.2
an assessment of the effectiveness of the proposed air quality and odour mitigation measures,	Construction – Section 6 Operation – Section 7
EPA Recommended SEARs	
Air Quality and Odour – including	
The impact on air quality including the management of odour generated at the premises, including assessment of impacts based on the EPA's Assessment and Management of Odour from Stationary Source NSW (2006). This must include identification of any necessary odour management and mitigation procedures/measures.	Operation – Section 7
Western NSW Local Health District	
Air Quality and Odour - including:	
Dust suppression – in particular slaughter and animal housing areas and around the site in general.	Construction – Section 6 Operation – Section 7

1.2 Study Scope

1.2.1 Construction Phase Impacts

Construction phase impacts are required to be assessed by the SEAR's. The scope of the construction phase component of the AQIA is limited to a high level risk-based (qualitative) assessment, the purpose of which is to identify potential impacts associated with the construction of the Project with respect to air quality, focussing on fugitive dust emissions, and identify any constraints from existing and proposed sources of emissions to air from local industry and commerce proximate to the Project Site.

The agreed scope of works for the Construction AQIA is summarised as follows.

- Data collation and review of proposed construction phase activities to identify the scale and nature of equipment and activities on site and the potential sources of fugitive emissions.
- Identify separation distances between the facility and existing receptors/nearby sensitive land uses and assess the sensitivity of the identified receptors to potential changes in air quality associated with emissions from the construction phase activities.
- Obtain and review data from nearby, representative Office of Environment and Heritage (OEH) air quality monitoring stations to characterise the background ambient air environment and to determine whether local air quality objectives are likely to be exceeded as a result of construction activities.
- Characterise the local meteorological environment using data obtained from the nearest and/or most representative Bureau of Meteorology (BoM) Automatic Weather Station (AWS) and assess its potential to exacerbate or mitigate air quality impacts at the identified sensitive receptor locations during construction works.
- Determine the potential for cumulative impacts at receptor locations based on a desk-based study of surrounding sources of emissions to air.
- Perform a qualitative risk-based assessment of identified activities to determine the risk of air quality impacts with no mitigation applied and taking into account prevailing weather conditions.
- Based on the results of the assessment, prescribe appropriate air quality control measures and proactive/response management procedures as necessary for ensuring that adverse air quality impacts do not occur at off-site sensitive receptor locations.

Recommendations provided in this report focus on air quality control and mitigation strategies that may be applied to the construction phase of the Project, to ensure that it does not result in a significant adverse impact upon air quality in the local area. This approach is considered appropriate for a high level qualitative study. No air quality monitoring or dispersion modelling has been undertaken as part of this assessment.

1.2.2 Operational Phase Impacts

Key emissions to air associated with the operation of the Project will comprise:

- Odour;
- Combustion emissions from the boilers; and
- Traffic-related dust and exhaust emissions, particularly in relation to road truck transport of stock/product.

The agreed scope of works for the Operational AQIA was as follows:

- Identify the relevant air quality and odour criteria applicable to the Project.

- Obtain meteorological data from the closest or most representative BoM site/s and use this dataset to analyse and describe the prevailing climatic conditions and provide input into the atmospheric dispersion modelling.
- Review potential sources of emissions to air associated with the project and estimate emission rates based on published emission factors and/or data supplied by manufacturers of process and control equipment (where available). This includes a sensitivity analysis to estimate the odour emission rate from goats (i.e. pheromone rather than manure).
- Compile an emission inventory representative of peak operations, considering the effectiveness of proposed air quality and odour mitigation measures.
- Use the TAPM/CALMET/CALPUFF dispersion modelling suite to predict worst-case concentrations of air pollutants (including odour) at the nearest sensitive receptors arising as a result of the operations.
- Assess the predicted air quality and odour impacts at the identified receptor locations and make recommendations for appropriate air quality/ odour control and management (as required).

2 PROJECT OVERVIEW

2.1 Site Description

2.1.1 Study Area and Surrounds

The site of the proposed small stock abattoir is located off the Mitchell Highway and is identified as Lot 17 in Deposited Plan (DP) 753546 within the local government area of Bourke. The 246 hectare (ha) Project site is zoned RU1 Primary Production in the Bourke Local Environmental Plan 2012. Zone RU1 allows for the development of abattoirs with appropriate consent.

The majority of land surrounding the Project site is also zoned RU1 Primary Production, with no major development nearby. The one exception is Lot 2 DP 753547 adjacent to the Project site, which is zoned R5 Large Lot Residential, although no residential development exists on this lot. CAPRA has entered into a conditional contract for the purchase of 2000 ha of land which includes the Project site (Lot 17) and Lot 2, as well as a number of other surrounding lots known as the Artisian Block. The additional lots are Lot 19 DP 753546, Lot 6297 DP 768182, Lot 100 DP 753547, Lot 102 DP 753547, Lot 4 DP 753547, and Lot 3 DP 753547.

The Bourke airport and the village of North Bourke are located to the south of the Project site, approximately 9 km and 10 km from the site respectively. The regional location of the proposed Bourke small stock abattoir is presented in **Figure 1**.

2.1.2 Sensitive Receptor Locations

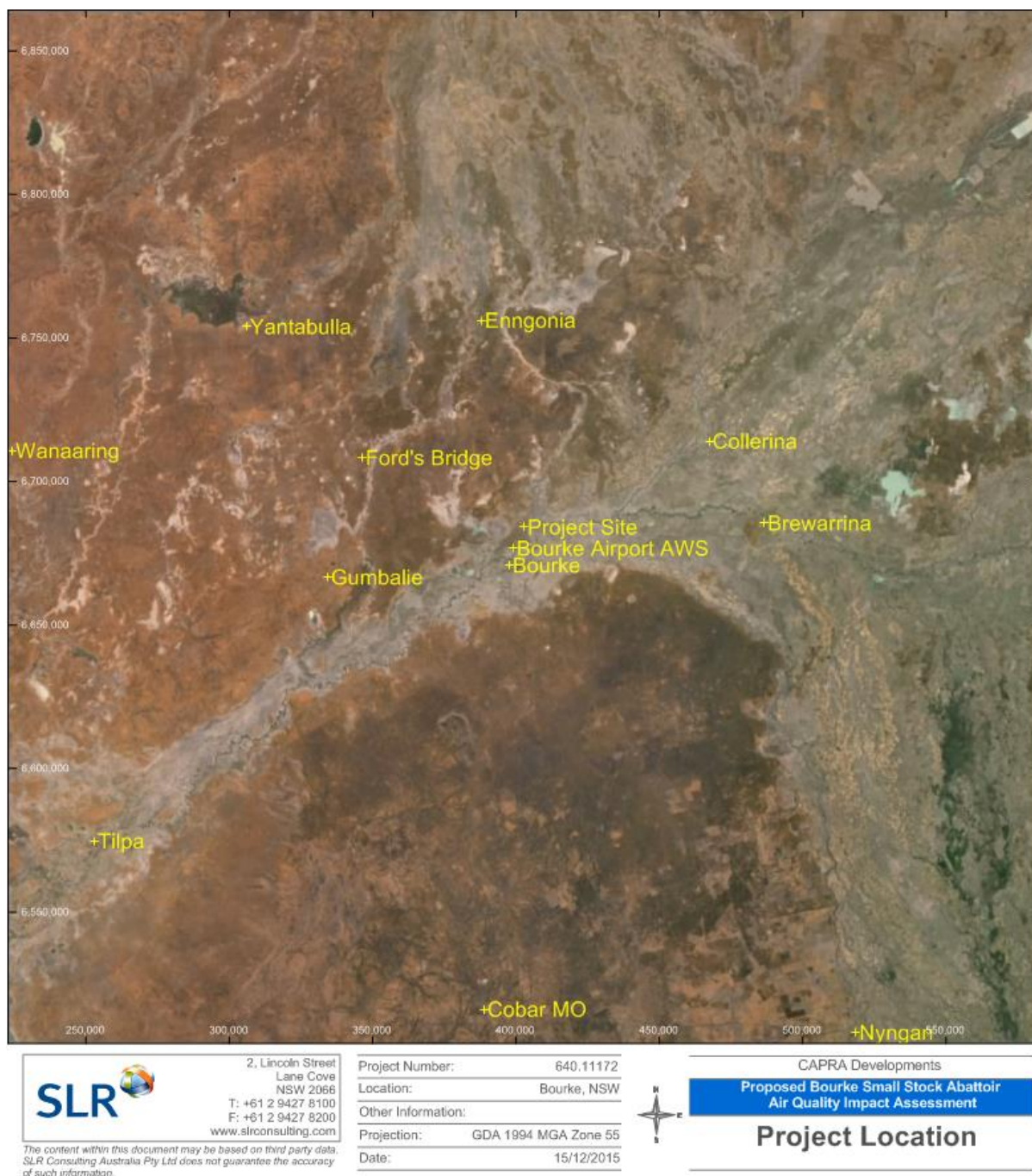
Two receptors representative of the surrounding land uses were included in the modelling study based on a desktop review of the area surrounding the Project site, as presented in **Figure 2** and **Table 2**. The locations of these receptors were also ground-truthed by CAPRA. Receptors 1 and 2 represent the nearest residential properties/zones. The receptors are assumed to be home to 2-3 permanent residents each.

There is a dwelling (402,791mE, 6,680,874mN) located approximately 3.3 km south of the Project site however it is abandoned and has not been classified as a receptor for this assessment.

Table 2 List of Surrounding Representative Receptors

Receptor ID	Easting (m, UTM)	Northing (m, UTM)	Type	Approximate Distance from Site (km) / Direction (degree true) ¹
Receptor 1	401,380	6,678,643	Residential	5.5 / SSW
Receptor 2	401,452	6,678,339	Residential	5.8 / SSW

Figure 1 Regional Locality

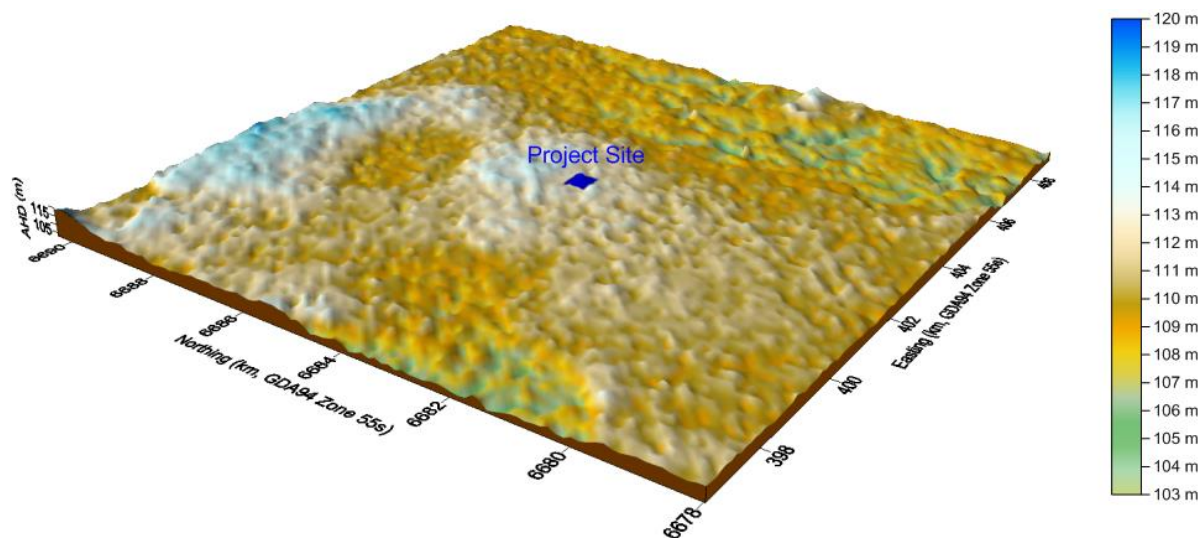


2.1.3 Local Topography

Topography is important in air quality studies as local atmospheric dispersion can be influenced by night-time katabatic (downhill) drainage flows from elevated terrain or channelling effects in valleys or gullies around the Project site.

A three dimensional representation of the area is given in **Figure 3**. The topography of the local area used as the model domain increases in a north-south direction from an approximate elevation range of 103 m to 120 m Australian Height Datum (AHD).

Figure 3 Topography of the Local Area



Note: Vertical exaggeration applied.

2.1.4 Local Meteorological Conditions

This section provides an overview of key climatic features of the Project site that have the potential to impact on the generation and dispersion of air emissions from the Project. Details of the meteorological data used in the modelling study performed for the operational phase of the Project are presented in **Section 7.1.3**.

The Bourke Airport AWS is located approximately 8.4 km to the southwest of the proposed Bourke Abattoir. The terrain between the two locations varies a maximum of 10 m between 110 – 120 m in elevation. The landscape surrounding the Project site has no significant terrain features to affect wind flows. Therefore, the Bourke Airport AWS provides a good indication of the meteorological conditions impacting the Project site.

2.1.4.1 Wind Speed and Direction

Local wind speed and direction influence the dispersion of air pollutants. Wind speed determines both the distance of downwind transport and the rate of dilution as a result of 'plume' stretching. Wind direction, and the variability in wind direction, determines the general path pollutants will follow and the extent of crosswind spreading. Surface roughness (characterised by features such as the topography of the land and the presence of buildings, structures and trees) will also influence dispersion.

Annual wind roses compiled from data recorded by the BoM Automatic Weather Station (AWS) at Bourke Airport during 2010 - 2014 are presented in **Figure 4**. On an annual basis, the dominant wind direction is southerly to south-southeasterly or easterly. Each year shows a low frequency of winds from the north (<4%) or north northeast (<6%), indicating there is low potential for air emissions from the construction and operation of the Project to be dispersed towards the nearest sensitive receptors.

The percentage of wind speeds that were recorded as calms range from 1.5% in 2011 to 2.8% in 2010. The worst case meteorological conditions for the dispersion of odours are characterised by low wind speeds. This low percentage of calms indicates that there are few occasions during the year where low wind speed conditions occur, and this is consistent across 5 years of data.

Annual and seasonal wind roses compiled from data recorded by the BoM Automatic Weather Station (AWS) at Bourke Airport during 2012 are presented in **Figure 5**. During summer, winds from the east predominate. By autumn, the south-southeasterly winds persist. Winds in winter swing further from the west to southwesterly directions, reflecting the frequent passage of cold fronts and general westerly flow, while in spring a transition occurs again with increasing easterly flows.

The representativeness of 2012 as the modelled year of meteorology is discussed in **Section 7.1.3**.

Figure 4 Annual Wind Roses - Bourke Airport AWS, 2010-2014

Bourke Airport AWS
(BoM)
2010 - 2014
640.11172

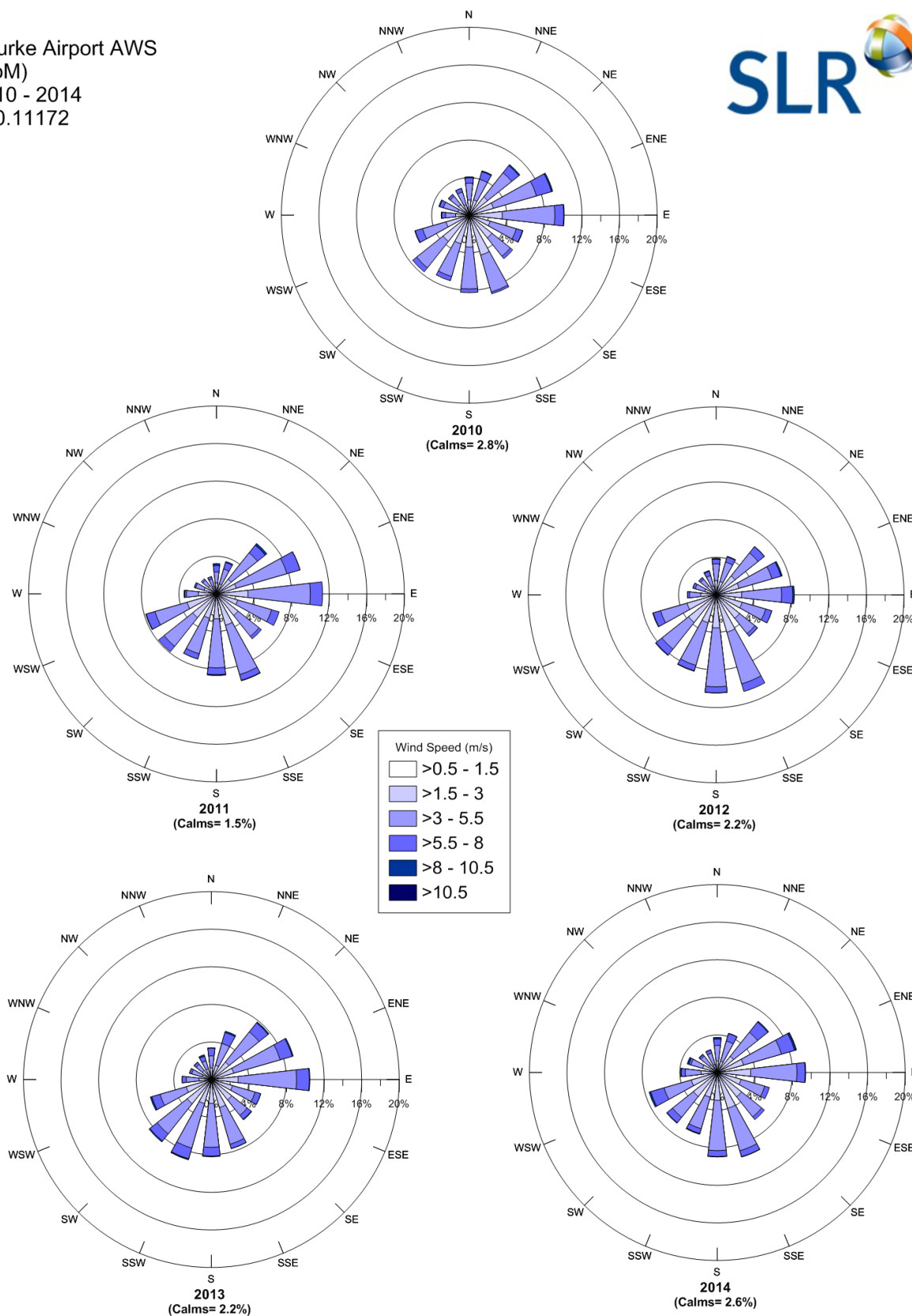
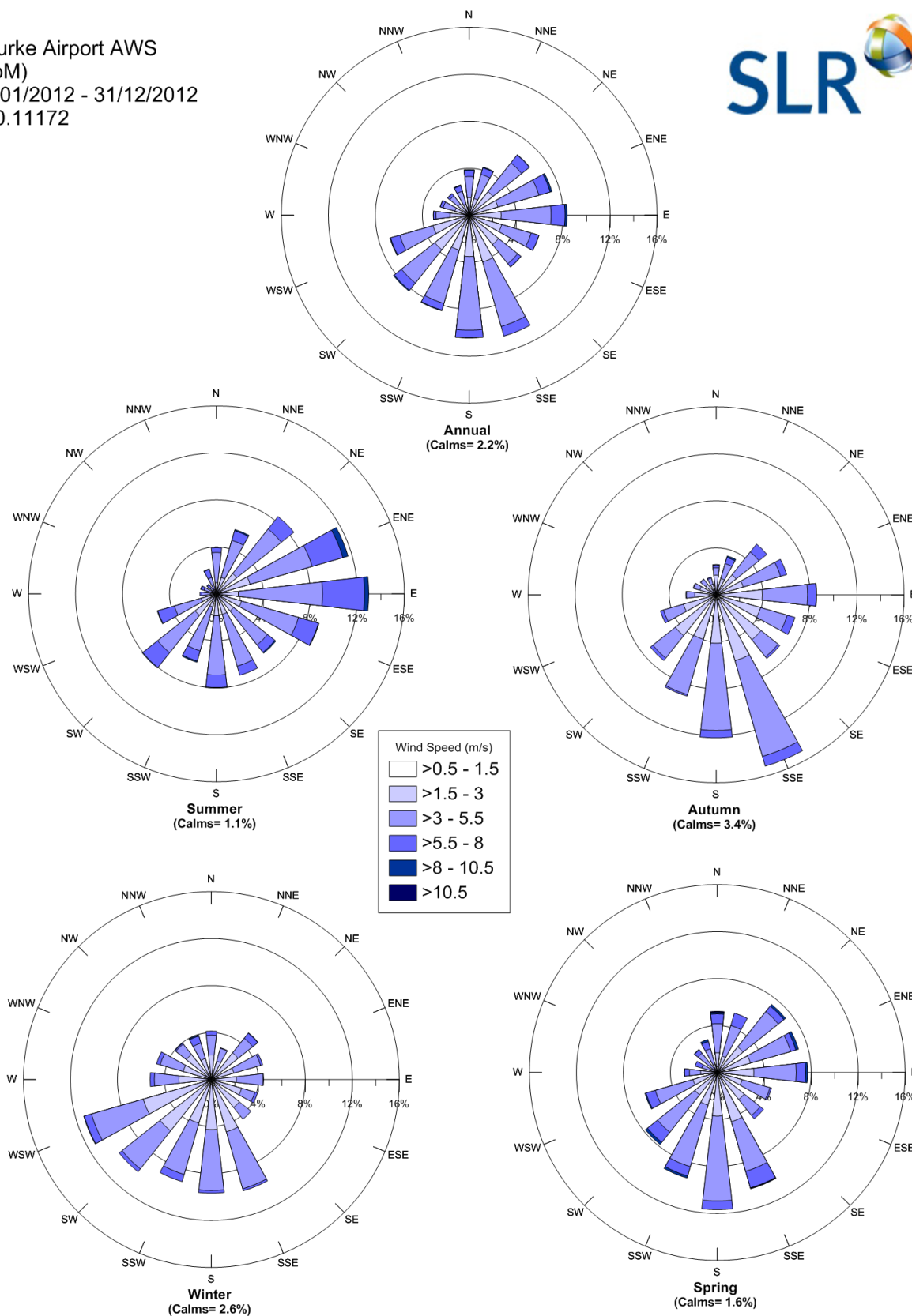


Figure 5 Annual and Seasonal Wind Roses - Bourke Airport AWS, 2012

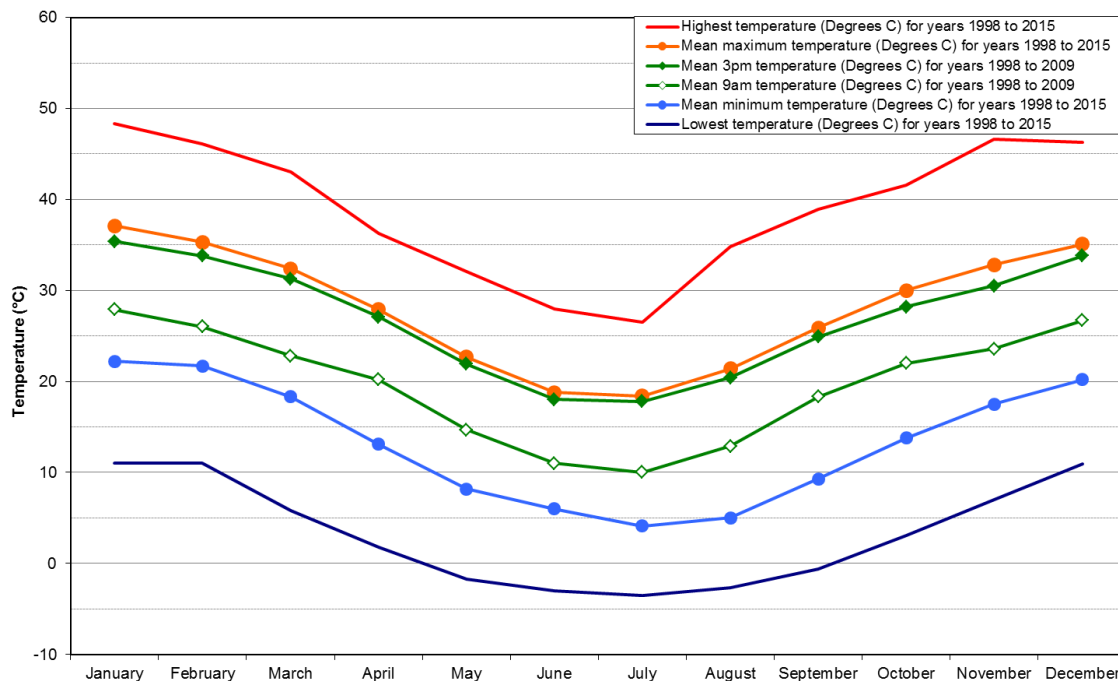
Bourke Airport AWS
(BoM)
01/01/2012 - 31/12/2012
640.11172



2.1.5 Temperature

Monthly mean maximum and minimum temperatures recorded at Bourke Airport AWS are presented in **Figure 6**. The data show that average maximum summer temperatures in the region often exceed 45°C. During the winter months the average maximum temperature falls below 20°C. Average minimum temperatures range from just above 20°C in summer to just below 5°C in winter.

Figure 6 Monthly Average Minimum and Maximum Temperatures Bourke Airport AWS (1998-2015)

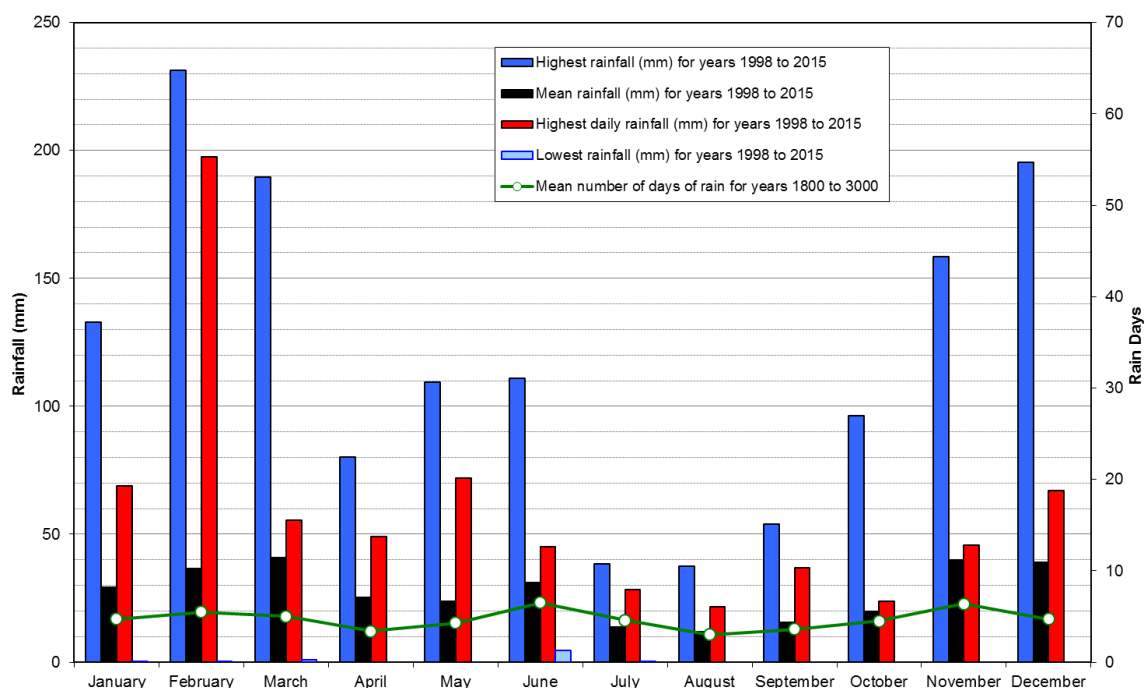


2.1.6 Rainfall

Long-term rainfall statistics for Bourke Airport AWS are summarised in **Figure 7**. Rainfall is relatively high in late spring and summer and tends to be lowest during winter and early spring. Peak rainfall occurs in late summer, with maximum daily rainfall occurring in February. The number of rain days in February is low (5-6), which also indicates that the peak rainfall occurs frequently over short periods.

Rain events provide natural suppression of dust from both natural and anthropogenic sources (ie wheel generated dust on unpaved road surfaces). A high average rainfall per month and a high number of rain days would provide the most natural suppression of dust. Given Bourke Airport AWS receives a low average rainfall per month and has a low number of rain days per month the natural suppression of dust from rain would be minimal and infrequent. This is relevant to the construction dust assessment when considering the natural dust suppression provided by rainfall.

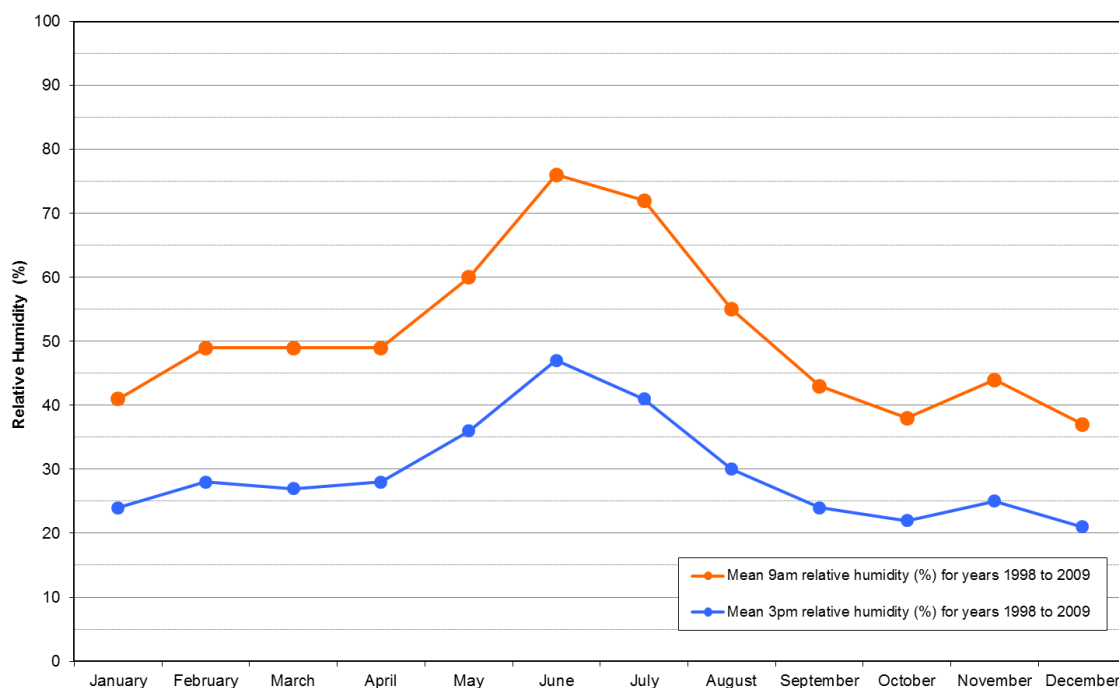
Figure 7 Monthly Average Rainfall Data – Bourke Airport AWS (1998-2015)



2.1.7 Relative Humidity

Monthly average 9 am and 3 pm relative humidity data for Bourke Airport AWS are presented in **Figure 8**. The humidity levels are higher in the morning compared to the afternoon. Levels are relatively higher in winter than they are in the summer months.

Figure 8 Monthly Average 9 am and 3 pm Relative Humidity – Bourke Airport AWS (1998 – 2009)



2.2 Project Description

The proposed Bourke small stock abattoir will have the capacity to process up to 6,000 head per day, comprising sheep, lamb, and goats. The disturbance footprint for the proposed new abattoir will be approximately 20 ha, comprising of a stock receipt area and holding yards, abattoir, staff amenities and office, vehicle manoeuvring and parking areas and wastewater treatment plant.

The complex will produce three types of meat products as demanded by the serviced export markets:

1. whole bone-in carcass with skin on;
2. whole bone-in carcass with skin off; and
3. six-way cut of carcass in cartons (skin off).

Livestock will be transported to the abattoir in semi-trailers and/or B-doubles or B-triples and off-loaded into watered receival yards adjoining the abattoir building. When ready for slaughter, the livestock will be moved to the holding pens and then the kill floor.

Products will be packed, chilled or frozen and transported off site for sale. There will be no on-site rendering of the raw animal waste products from the abattoir (offal, bone, blood, fat and trimmings) or any on-site skins processing.

2.2.1 Stock Holding Area

The holding yards will be regularly dry cleaned (ie raking or scraping), with the collected manure removed from the yards and stockpiled on site for reuse. The yards will also be washed out on a weekly basis, with the wash down water collected and directed to the wastewater treatment system.

2.2.2 Kill Floor

Small stock will be corralled into the kill floor which will be cooled and will be maintained under positive pressure. Waste water from the slaughter floor, including residual blood products, will be diverted to the wastewater treatment process.

Animal skins from the abattoir will be collected in an open bin and transported to an off-site skins treatment facility. By-product (ie offal, bone, blood, fat and trimmings) from the slaughter floor will be gathered into covered bins and will be collected by a licensed contractor daily for transport in enclosed trucks to an off-site licenced rendering facility.

The building is under positive pressure to maintain food safety requirements and will prevent odours and potential dust from the holding pens from entering the kill floor. Consequently, fugitive emissions of odour from the kill floor may potentially be emitted from the building.

2.2.3 Water and Wastewater Treatment

All operational wastewater generated by the Project will be treated on-site in a specifically designed automated wastewater treatment system. The process will involve coarse screening, dissolved air flotation (DAF), and the use of settlement and anaerobic treatment ponds. Treated effluent from the ponds is anticipated to be utilised for on-site irrigation of paddocks on the Project site.

Anaerobic ponds naturally form a crust which assists in controlling odour from the ponds. When the ponds are initially filled, and while the crust is forming, straw will be placed across the surface of the ponds to increase the rate of crust formation. Further, the ponds are over 5.5 km away from the nearest residence ensuring a significant distance from sensitive receptors.

Treated effluent from the ponds will be reused via spray irrigation of paddocks within the Project site. The irrigation method will ensure droplet size is controlled to minimise the risk of spray drift, and irrigation scheduling will ensure irrigation only occurs when the soil and crop require moisture, minimising the potential for runoff from the area. A 15 m wide vegetative buffer zone consisting of grasses, shrubs and trees will be maintained immediately downslope of the irrigation area to slow down and capture any runoff that occurs from the irrigation area, and to further assist in minimising the risk of spray drift offsite. Further information on the planned irrigation to occur on-site is provided in the On-site Effluent Management Study prepared by Envirowest Consulting Pty Ltd (2016), which is included as Appendix K of the Environmental Impact Statement (EMM 2016) for the Project.

2.2.4 Boilers

Steam will be generated for sterilisation and cleaning uses by gas fired boilers, which are proposed to have an installed capacity of 1.5 megawatts (MW) to 3 MW. The boilers will be operational up to 24 hours a day. The burner fitted to the boiler will be a gun type burner, fitted with an AGA approved gas train, and burner management system. This Burner is of the forced draft type, designed to provide complete combustion within the furnace. The combustion efficiency is guaranteed at 80%. The full details of the boiler specifications are provided in **Appendix D**.

2.3 Hours of Operation

The Bourke small stock abattoir is proposed to operate 24 hours a day, seven days per week.

2.4 Vehicular Access and Parking

Access to and from the site will be via Mitchell Highway. All new access roads and manoeuvring areas will be appropriately designed to carry the anticipated heavy vehicle movements and will be unsealed, except for the first 50 m from the highway.

2.5 Traffic Generation

The primary operational activities that will generate traffic to and from the Project Site are outlined in **Table 3**. With the exception of livestock delivery, all heavy vehicle activities should occur during daylight hours and they will be relatively evenly spread (i.e. no peak periods).

Table 3 Estimated Traffic Volumes

Activity	Vehicle Type	Daily Vehicle Movements (Two Way Vehicle Trips)
Heavy Vehicles		
Delivery of livestock	Semi-trailer and/or B-double	5
Delivery of consumables	Semi-trailer	1
Removal of meat products from the abattoir	Semi-trailer and/or B-double	3
Removal of meat waste products	Rigid truck	3
Removal of general garbage	Rigid truck	1
Maintenance	Rigid truck	1
Heavy Vehicle Sub-Total		14
Light Vehicles		
Staff abattoir	Car	130
Tradesman	Ute/Van	2
Light Vehicle Sub-Total		132
TOTAL		146

2.6 Construction Activities

Information on the proposed construction activities are presented in **Table 4**. Details on earthwork areas have been estimated through a review of the architectural drawings provided, supplemented by a desk-top assessment from Google Earth aerial photography.

All roads will be surfaced with gravel during construction. Upon completion of the construction phase, the first 50 m of the access road from Mitchell Highway will be sealed, and the rest of the internal roads around the abattoir will be gravel. Construction traffic travelling to/from the site will enter and exit the site via Mitchell Highway, which is a sealed road.

Table 4 Construction Activity Details

Activity	Description	Detail
Construction (holding pens, processing, chilling facilities plus associated ancillary buildings, sheds etc)	Earthworks area for construction of buildings etc	53,653 m ²
	Holding Pen area	9,752 m ²
	Holding Pen volume	119,462 m ³
	Processing building area	3,901 m ²
	Processing building volume	47,787 m ³
Construction Traffic	Trucks transporting skips and waste from site	1 truck per day
	Trucks transporting building materials and concrete to the site	14 per day (28 vehicle movements). This is highly conservative as it is unlikely this number of movements will be needed over the entire construction period.
	Trade utes/vans and workers cars travelling to/from the site	13 vehicles per day (27 FTE construction workers, assuming 50% car-pooling)
Vehicles / plant operational on site	Grader (1)	Operational time - 16 weeks
	Scraper (1)	Operational time - 6 weeks
	Dozer (1)	Operational time - 8 weeks
	Excavator (1)	Operational time - 16 weeks
	Tip Truck (4)	Operational time - 16 weeks
	Backhoe (1)	Operational time - 25 weeks
	Concrete trucks (2)	Operational time - 20 weeks
	Concrete pump (1)	Operational time - 5 weeks
	General cargo trucks (3)	Operational time - 35 weeks
	Mobile crane (1)	Operational time - 20 weeks

3 FACTORS AFFECTING AIR QUALITY

The following section identifies the potential sources of air emissions associated with the construction and operational phases of the Project and provides an overview of the potential nuisance-related impacts and health issues associated with the key pollutants identified.

In relation to the following discussion, emissions to air may be categorised as either controlled emission sources or uncontrolled ("fugitive") emissions. Controlled emission sources are typically directed into a vent or stack and emitted to atmosphere. Fugitive emissions are uncontrolled releases and may be due to accidental spillage, leakage, materials handling, transfer or storage.

3.1 Identification of Potential Air Emissions

3.1.1 Construction Phase

The potential for a construction site to generate air quality impacts is related to the activities being undertaken (e.g. demolition, earthworks, construction, dirt trackout etc), and the duration, frequency and scale of these activities. The building type (i.e. construction materials used) and the staging and/or timing of construction activities during the year (i.e. seasonality) will also influence the potential for air quality impacts.

Key potential air quality impacts associated with the construction phase works include:

- Nuisance dust and particulate matter emitted from the proposed works, particularly where earthworks and site preparatory works are required.
- The emission of products of combustion (including oxides of nitrogen [NO_x], carbon monoxide [CO], carbon dioxide [CO₂], sulphur dioxide [SO₂], volatile organic compounds [VOCs] and particulate) in vehicle exhaust emissions from construction equipment (i.e. trucks, excavators, bulldozers, generators, etc) and worker transport (i.e. light vehicles).
- Fugitive release of VOC emissions from the storage, transfer or accidental spillage of diesel and other fuels.
- Emissions of dust and fumes from workshops (e.g. from sanding, welding and the use of solvents for cleaning equipment parts).
- Potential fugitive release of odorous emissions during intrusive earthworks.

3.1.2 Operational Phase

The operational activities that have the potential to cause emissions to air, and the pollutants likely to be emitted are outlined in **Table 5**. The Project will not undertake on-site rendering nor will skins be processed on site. Therefore, as shown in **Table 5**, the key sources of air emissions during the operational phase will be:

- Odour generation due to the operation of the wastewater processing system; and
- Exhaust emissions from the boilers.

Table 5 Potential Air Pollutant Emissions from Integrated Meat Processing Plants

Operation	Type of Emission	Pollutants Emitted	Comments
Abattoir Sources			
Holding pens/yards	Fugitive	Particulate matter	Holding pens are all hardstand with the stock elevated on the second level to allow easy cleaning of manure. Dust emissions are expected to be minimal following dust management practices.
	Point	Odour	Yards are expected to be a source of odour from the collection of manure. Holding pens will be open on all sides with a roof covering. Male goats in rut that are kept in the yard may emit body odour.
Kill floor	Fugitive	Odour	Building is under positive pressure. Therefore potential fugitive emissions of odour may be emitted via open doors.
Blood products	Fugitive	Odour	Blood will be segregated, collected and transported off-site for processing.
Skins	Fugitive	Odour	Animal skins will be collected and stored separately in bins located under the kill floor, which will be covered with open sides. The bins will be loaded onto enclosed truck/trailers and transported daily to an existing off-site skins treatment facility for processing.
Paunch	Fugitive	Odour	Paunch will be stored in open bins under the kill floor. It will be mixed with the material from the DAF, put through a belt press to reduce water content and the solid waste sent off site to landfill.
Wastewater Sources			
Rotary screen	Fugitive	Odour	Wastewater will first be directed to a rotary screen, with 1-2 tonnes of screenings expected to be removed per day.
Screenings bin	Fugitive	Odour	Screenings will be collected into a bin and removed off-site for treatment.
Dissolved Air Flootation (DAF)	Fugitive	Odour	The DAF will have a slight odour of ammonia and sulphide compounds.
Anaerobic treatment ponds (4)	Fugitive	Odour	If not covered, can emit strong hydrogen sulphide odour, however some anaerobic systems have crust formation and this can aid in odour reduction.
Ancillary			
Boiler for generation of steam for cleaning	Point	Products of combustion	The boilers will be fuelled by gas. They will generally operate 24 hours a day.
Onsite traffic (stock delivery, product transport etc):			
exhaust	Fugitive	Products of combustion	Due to traffic numbers to site, exhaust emissions will be minimal in context of the surrounding environment. It is assumed these emissions are adequately captured in background data.
wheel generated dust	Fugitive	Particulate matter	Internal truck traffic will be limited to approximately 1-2 trucks / hour. Employee vehicle movements will displace less dust than heavy vehicles but there will be around 130 vehicles per day. However, wheel generated dust will be minimal with adequate management practices.
Onsite mobile machinery (ie forklifts):			
exhaust	Fugitive	Products of combustion	The number of internal vehicles on site will be minimal and emissions will likewise be minimal in context of the surrounding environment
wheel generated dust	Fugitive	Particulate matter	The main access road into the site will be paved for the first 50m. Truck traffic will be limited to approximately 1-2 trucks / hour. Therefore wheel generated dust will be minimal with adequate management practices.

3.2 Overview of Key Pollutants

A general overview of key pollutants that have the potential to be emitted by the Project is provided below.

3.2.1 Particulate Matter

The term “particulate matter” refers to a category of airborne particles (including solid particles, liquid droplets and aggregates of particles and liquids) that range from 0.1 microns (μm) to 50 μm in aerodynamic diameter and represents a complex mixture of organic and inorganic substances. Typical particle sizes are detailed in **Table 6**.

Table 6 Typical Particle Sizes for Particulate Matter

Pollutant	Example of Particle Sizes
Dust	> 30 - 50 microns
Total Suspended Particulates (TSP)	< 30 - 50 microns
PM ₁₀	< 10 microns
PM _{2.5}	<2.5 microns

Note: A micron (μm) is one-millionth of a metre ($1 \times 10^{-6}\text{m}$).

3.2.1.1 Particulate Matter (as PM₁₀ and PM_{2.5})

Particles less than 10 μm and 2.5 μm are referred to as PM₁₀ and PM_{2.5} respectively. Emissions of PM₁₀ and PM_{2.5} are considered important pollutants due to their ability to penetrate into the human respiratory system as this can lead to a variety of health effects including heart or lung disease. Smaller particles can remain suspended in the air for long periods of time and can travel significant distances until removed from the atmosphere by deposition or by removal by rain.

Anthropogenic sources of particles include combustion sources (i.e. residential wood burning, motor vehicles, agricultural burning, and some industrial processes), and a range of industrial emissions that includes (but is not limited to) coal mining, crushing and grinding, and materials handling and transfer. Other significant natural sources of PM₁₀ and PM_{2.5} in Australia include wind erosion, bushfires and dust storms. The Project sources of PM₁₀ and PM_{2.5} will include operation of the boilers, exhaust emissions from vehicles, and a small component of the wheel generated dust from traffic movements.

3.2.1.2 Nuisance Dust and Total Suspended Particulate (TSP)

Amenity impacts from dust are usually associated with coarse particles and particles larger than PM₁₀. Amenity concerns can relate to “visibility” of dust plumes, and amenity impacts may result from dust depositing on fabrics (i.e. washing), balconies, window sills and cars, and the transport of dust from roofs to water tanks (i.e. ‘silting’).

TSP refers to all particulates suspended in the air and is a good indicator of nuisance dust impacts. The measurement of dust deposition rates (in $\text{g}/\text{m}^2/\text{month}$) is also a measure of nuisance dust impacts. The Project sources of TSP will predominantly include wheel generated dust from traffic movements.

3.3 Oxides of Nitrogen (NO_x)

Oxides of nitrogen (NO_x) is a general term used to describe any mixture of nitrogen oxides formed during combustion. In atmospheric chemistry NO_x generally refers to the total concentration of nitric oxide (NO) and nitrogen dioxide (NO₂).

NO is a colourless and odourless gas that does not significantly affect human health. However, in the presence of oxygen, NO can be oxidised to form NO₂ which can have significant health effects including damage to the respiratory tract and increased susceptibility to respiratory infections and asthma. Long term exposure to NO₂ can lead to lung disease.

NO is converted to NO₂ after being emitted to atmosphere at a rate dependent upon the atmospheric concentrations of ozone and volatile organic compounds and the amount of sunlight.

3.4 Carbon Monoxide (CO)

Carbon monoxide (CO) is an odourless, colourless gas formed from the incomplete burning of fuels in motor vehicles. CO bonds to the haemoglobin in the blood and reduces the oxygen carrying capacity of red blood cells, thus decreasing the oxygen supply to the tissues and organs, in particular the heart and the brain.

It can be a common pollutant at the roadside and highest concentrations are found at the kerbside with concentrations decreasing rapidly with increasing distance from the road. CO in urban areas results almost entirely from vehicle emissions and its spatial distribution follows that of traffic flow.

3.5 Odour

Impacts from odorous air contaminants are often nuisance-related rather than health-related. Odour performance goals guide decisions on odour management, but are generally not intended to achieve “no odour”.

The detectability of an odour is a sensory property that refers to the theoretical minimum concentration that produces an olfactory response or sensation in 50% of the population. This point is called the *odour threshold* and defines 1 odour unit (OU). An odour goal of less than 1 OU would theoretically result in no odour impact being experienced.

In practice, the character of a particular odour can only be judged by the receiver's reaction to it, and preferably only compared to another odour under similar social and regional conditions. Based on the literature available, the level at which an odour is perceived to be a nuisance can range from 2 OU to 10 OU depending on a combination factors including population sensitivity, background level, public expectation (considered offensive or easily tolerated), source characteristics (i.e. emitted from a stack or general area) and health effects.

Odour performance goals need to be designed to take into account the range in sensitivities to odours within the community, and provide additional protection for individuals with a heightened response to odours, using a statistical approach which depends on the size of the affected population.

It is often not possible or practical to determine and assess the cumulative odour impacts of all odour sources that may impact on a receptor in an urban environment. Therefore, the proposed odour performance goals allow for population density, cumulative impacts, anticipated odour levels during adverse meteorological conditions, and community expectations of amenity.

4 RELEVANT AIR QUALITY LEGISLATION AND GUIDANCE

4.1 Regulatory Framework

4.1.1 National Environmental Protection Measure (Ambient Air Quality)

The National Environment Protection (Ambient Air Quality) Measure (Ambient Air Quality NEPM) was established in 1998 to provide a common national goal to best protect human health and well being from the adverse impacts of air pollution. It provides a consistent framework to assess Australia's ambient (outdoor) air quality. It sets national ambient air quality standards for six common air pollutants as well as mandatory monitoring and reporting requirements against these standards. The NEPM standards are intended to be applied at background monitoring locations that represent air quality for a region or sub-region of more than 25,000 people.

State and Territory governments implement legislation, statutory instruments, policies and programs in their own jurisdictions in order to meet the Ambient Air Quality NEPM standards.

The 2011 review of the Ambient Air Quality NEPM provided recommendations in relation to the standards for particles, including revising the standards to take into account new evidence around the health effects of air pollution. On 29 April 2014, Environment Ministers signalled their intent to vary the Ambient Air Quality NEPM based on the latest scientific understanding of the health risks resulting from airborne particulate pollution. On 15 July 2015, Ministers agreed in-principle to adopt reporting standards for annual average and 24-hour PM_{2.5}. Ministers agreed to finalise their consideration of the matter by 31 December 2015, including appropriate standards for PM₁₀.

4.1.2 National Clean Air Agreement

The National Clean Air Agreement (NCAA) was endorsed by Commonwealth, state and territory Environment Ministers on 15 December 2015. Ministers agreed to strengthen national ambient air quality reporting standards for airborne fine particles as follows:

For PM₁₀:

- a 24-hour average concentration of 50 µg/m³ (unchanged from the Approved Methods); and
- an annual average of 25 µg/m³ (compared to a value of 30 µg/m³ in the Approved Methods).

For PM_{2.5}:

- a 24-hour average concentration of 25 µg/m³; and
- an annual average concentration of 8 µg/m³.

All jurisdictions have agreed to implement strengthened standards for particles, as well as move to even tighter standards for annual average and 24-hour PM_{2.5} in 2025.

4.1.3 Protection of the Environment Operations Act 1997 & Amendment Act 2011

The *Protection of the Environment Operations (POEO) Act 1997* (and the Amendment Act 2011) form a key piece of environment protection legislation administered by the EPA which enables the NSW Government to establish instruments for setting environmental standards, goals, protocols and guidelines.

The following sections of the POEO Act are of general relevance to the Project.

- Section 117 of the POEO Act states that the wilful or negligent release of ozone depleting substances such as chlorofluorocarbons (CFCs) to the atmosphere carries the highest of all penalties under NSW environmental law.

- Section 124 and 125 of the POEO Act state that any plant located at a premise should be maintained in an efficient condition and operated in a proper and efficient manner to reduce the potential for air pollution.
- Section 126 of the POEO Act requires that materials are managed in a proper and efficient manner to prevent air pollution.
- Section 128 of the POEO Act states:
 - The occupier of a premises must not carry on any activity or operate any plant in or on the premises in such a manner to cause or permit the emission at any point specified in or determined in accordance with the regulation of air impurities in excess of [the standard of concentration and/or the rate] prescribed by the regulations in respect of any such activity or any such plant.
 - Where neither such a standard nor rate has been so prescribed, the occupier of any premises must carry on activity, or operate any plant, in or on the premises by such practicable means as may be necessary to prevent or minimise air pollution.
- Section 129 of the POEO Act states that offensive odours generated by operational activities should not be detectable beyond the site boundary.
- Section 133 of the POEO Act states that the EPA may prohibit the burning of fires in the open or burning of waste in an incinerator. These activities are illegal in most local Council areas.

Changes under the POEO Amendment Act 2011 include that the owner of a premises, the employer or any person carrying on the activity which causes a pollution incident is to *immediately* notify the relevant authorities when material harm to the environment is caused or threatened.

4.1.4 Protection of the Environment Operations (Clean Air) Regulation 2010

The POEO (Clean Air) Regulation 2010 (the Regulation) is the core regulatory instrument for air quality issues in NSW. In relation to industry, the Regulation:

- sets maximum limits on emissions from activities and plant for a number of substances.
- deals with the transport and storage of volatile organic liquids.
- restricts the use of high sulphur liquid fuel.
- imposes operational requirements for certain afterburners, flares, vapour recovery units and other treatment plant.

Part 5 (Division 3) of the Regulation deals with the emissions of air impurities from activities and plant and sets maximum limits on emissions for a number of substances (including solid particles and visible smoke). The standards of concentrations prescribed by Part 5, Division 3 do not apply to or in relation to any plant during start-up and shutdown periods, however are still subject to requirements of Section 128 (2) of the POEO Act in relation to the prevention and minimisation of air pollution.

The Regulation notes that the EPA may grant an exemption in relation to smoke emitted in the course of activities such as research to improve safety in relation to the flammability of materials and smoke reduction or testing undertaken to certify that manufactured or imported products comply with Australian Standards, International Standards or meet any legislative requirements place on them.

Part 6 of the Regulation outlines the control of VOCs and the requirement for any fuel burning equipment or industrial plant to be fitted with control equipment. Exemptions exist where approved by the EPA.

4.1.5 The Approved Methods for the Modelling and Assessment of Air Pollutants in NSW

The EPA's Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (NSW DEC, 2005) (hereafter the Approved Methods) lists the statutory methods for modelling and assessing air pollutants from stationary sources and specifies ground level air quality impact assessment criteria for key air pollutants to achieve appropriate environmental outcomes and to minimise associated risks to human health. The Approved Methods are referred to in the POEO (Clean Air) Regulation 2010 for assessment of impacts of air pollutants.

The air quality assessment criteria specified in the Approved Methods that are relevant to the Project and have been adopted for use in this assessment are summarised in **Section 4.2**. These criteria and guideline reporting goals have been sourced from the National Environmental Protection Council (NEPC); their published National Environment Protection Measure for Ambient Air Quality (Air NEPM) and Variation to Air NEPM, which outline agreed national objectives for protecting air quality for criteria pollutants.

4.1.6 Odour Technical Framework and Notes

The EPA's Odour Technical Framework document (Assessment and Management of Odour from Stationary Sources in NSW (Department of Environment and Conservation, 2006)) provides a policy framework for assessing and managing activities that emit odour and offers guidance on dealing with odour issues. It outlines:

- the legislation that applies to odour assessment and management in NSW;
- a fair and transparent process for assessing odour impacts from new developments;
- a system to help protect the environment and community from odour impacts while promoting fair and equitable outcomes for odour-emitting activities; and
- a technical reference document for proponents/developers, planners and regulators.

The Framework is accompanied by the Technical Notes: Assessment and Management of Odour from Stationary Sources in NSW, which provides detailed odour assessment procedures.

The odour assessment methodologies and criteria specified in the Technical Framework are adopted in the Approved Methods. A summary of the impact assessment criteria specified by EPA in the Technical Framework and the Approved Methods for complex mixtures of odorants, as would be emitted by the Project, is given in **Table 7**. The Approved Methods states that the impact assessment criteria for complex mixtures of odorous air pollutants must be applied at the nearest existing or likely future off-site sensitive receptor(s).

Section 2.1.2 details the sensitive receptors identified in the local environment. There are two (2) residential dwellings within approximately 10 km of the site, and a further dwelling that is abandoned. The two residences have been included as receptors to determine if they are impacted by odours emitted from the Project site. Therefore, the total population to be considered is the 4-6 permanent residents at Receptors 1 and 2. An impact assessment criterion of 6.0 OU was therefore applied in this assessment.

Table 7 Impact Assessment Criteria - Complex Mixtures of Odorous Air Pollutants

Population of Affected Community	Impact Assessment Criteria for Complex Mixtures of Odours (OU, nose-response-time average, 99 th percentile)
Urban area (≥ 2000)	2
~500	3
~125	4
~30	5
~10	6
Single residence (≤ 2)	7

Source: Approved Methods 2005

4.1.6.1 Peak to Mean Ratios

It is a common practice to use dispersion models to determine compliance with odour goals. This introduces a complication because dispersion models are typically restricted by the meteorological data inputs to predicting concentrations over an averaging period of 1-hour or greater. The human nose, however, can respond to odours over periods of the order of one second. During longer periods, odour levels can fluctuate significantly above and below the mean depending on the nature of the source.

To determine the ratio between the one-second peak concentrations and longer period average concentrations (referred to as the peak to mean ratio) that might be predicted by a dispersion model, the EPA commissioned a study by Katestone Scientific Pty Ltd (1995, 1998). This study recommended peak to mean ratios for a range of circumstances. The ratio is also dependent on atmospheric stability and the distance from the source. For area sources, as applies predominantly in this case, the peak to mean ratio is 2.3 for stability classes A to D, and 2.5 for E and F class stability. For volume sources, the factor is 2.3 and is not dependant on stability.

The estimated odour emission rates used in the operational phase modelling study has accounted for these peak to mean ratios to enable direct comparison of the results against the goals shown in **Table 7** which are based on nose-response time.

4.2 Air Quality Impact Assessment Criteria Adopted for Use in this Assessment

A summary of the impact assessment criteria specified in the Approved Methods for the pollutants identified in **Section 3** is given in **Table 8** (NSW OEH, 2005).

Table 8 Summary of Current Air Quality Impact Assessment Criteria

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	Source
PM ₁₀	24 hours	50	NEPC (1998)
	Annual	30	EPA (1998)
PM _{2.5}	24 hours	25	NEPM (2003)
Total Suspended Particulate (TSP)	Annual	90	NHMRC (1996)
NO ₂	1-hour	246	NEPC (1998)
	Annual	62	NEPC (1998)
Pollutant	Averaging Period	Concentration (mg/m^3)	Source
CO	15-min	100	WHO (2000)
	1-hour	30	WHO (2000)
	8-hour	10	NEPC (1998)
Pollutant	Averaging Period	Incremental Increase / Total ($\text{g}/\text{m}^2/\text{month}$)	Source
Deposited Dust	Annual	2 / 4	NERDDC (1988)
Pollutant		Impact Assessment Criteria for Complex Mixtures of Odours (OU)	Source
Nuisance Odour	Nose-response time	6.0	EPA (2001)

4.3 Review of Recommended Buffer Distances

In situations where the specifics of a development are unknown (i.e. the potential locations of residential developments, or the nature, scale and potential impact of industrial or commercial land uses), the application of buffer distances provide a valuable 'screening' tool to judge whether a detailed assessment is required to evaluate the potential risk of conflicting land uses.

Reference has been made to Victoria Environment Protection Authority (VIC EPA) documentation for relevant referenced buffer distances. The NSW EPA also makes reference to these buffer distances on their website at <http://epa.nsw.gov.au/mao/abattoirs.htm>.

In accordance with Clause 13.04-2 (Air Quality) of Victoria's State Planning Policy Framework, all planning must consider the VIC EPA's "*Recommended Separation Distances for Industrial Residual Air Emissions*" (2013). In their document, the VIC EPA makes recommendations for assessing appropriate separation distances where amenity may be reduced for sensitive or incompatible land uses. Sensitive land uses which warrant protection from amenity-reducing off-site effects of industry by maintenance of a buffer distance include residential areas and zones, hospitals and schools.

A summary of the industrial residual air emissions (IRAE) buffer distances that relate to the food, beverages and manufacturing industry are provided below in **Table 9**. These values have been provided for context only and are not regulatory guideline values.

Table 9 VIC EPA Recommended Buffer Distances for Industrial Residual Air Emissions¹

Industry Type ²	Recommended Buffer Distance (m) ³
Abattoir – no rendering (>200 T per year)	500

Notes:

1. IRAEs are defined by the VIC EPA as unintended or accidental emissions (i.e. due to equipment failure, abnormal weather conditions etc) which are often episodic in occurrence and may originate near ground level.
2. For industries processing >200 tonnes per year.
3. Buffer distances are recommended for large scale operations. The NSW EPA should be consulted in relation to recommended buffer distances for smaller scale operations.

The ACT Government has issued a draft guidance document relating to the establishment of buffer distances between processes with significant emissions to air and sensitive land uses, as a tool for the development application process (EPA (2014) *Draft Separation Distance Guidelines for Air Emissions*). It is noted that the guidance document is still in a 'draft for consultation' phase. However the relevant draft guidance separation distance relating to abattoirs has been reproduced from EPA (2014) Appendix 1 in **Table 10** below.

Table 10 ACT EPA Recommended Separation Distances for Airborne Emissions

Activity	Description of Activity	Separation Distance (m)
Abattoirs or slaughterhouses	The conduct of slaughtering works for commercial purposes for the production of meat or meat products for human or animal consumption:	
	Other than poultry	500
	Poultry only	300

It is noted that the draft ACT EPA separation distance is numerically identical to that specified by VIC EPA.

The two nearest identified receptors to the Project site, receptor 1 and 2, are over 5 km from the site, and are therefore well beyond the recommended 500 m buffer distance.

5 EXISTING AIR QUALITY

5.1 Surrounding Industrial Sources of Airborne Pollutants

The following sources have been identified from desktop mapping study of sites regulated under by EPA and those that are required to report to the National Pollutant Inventory (NPI).

Environment Protection Licences (EPL) are issued under the POEO Act and are regulated by the NSW EPA. EPLs stipulate emission limits to water, land and/or air and provide operational protocols to ensure emissions/operations comply with relevant standards. General requirements of EPLs relating to air quality include:

- Plant and equipment to be maintained and operated in a proper and efficient manner.
- Emissions of dust and odour are to be minimised/prevented from the premises.

The NPI database provides details on industrial emissions of over 4,000 facilities across Australia. The requirement to return emissions estimates to the NPI is determined by the activities/processes being undertaken at the facility, and also whether those processes exceed process-specific thresholds in terms of activity rates (i.e. throughput and/or consumption). It is not intended to make a statement that impacts associated with those activities will be significant in terms of their potential for impact, generation of complaint, or constraint to the development of the Project site.

A search of the EPA public register and NPI database for the Bourke Shire Local Government Area (LGA) and postcode "2840" returned the following information for existing industries in the vicinity of the subject land.

Table 11 provides an overview of those industries regulated by the EPA and two listed in the NPI data search.

Table 11 Surrounding Industrial Sources

Facility Name	Sector	Address	Distance from Site	EPL/NPI Requirements
Caltex Energy NSW Bourke Depot	Petroleum product wholesaling	82-86 Anson Street Bourke	15 km SSW	N/A
Shell Bourke Airport	Aircraft refuelling	Bourke Airport Mitchell Highway Bourke	9 km SSW	N/A
Bourke Shire Council	Sewage treatment	Long Meadows Road Bourke	~10 km SSW	No condition in this licence identifies a potentially offensive odour.
Lorraine Lewis	Mining for minerals	Mitchell Highway Enngonia	70 km NNW	The premises must be maintained in a condition which minimises or prevents the emission of dust from the premises.
Namoi Cotton Co-operative Ltd	General agricultural processing	Wanaaring Road Bourke	~15 km SW	There are limits on the emissions of dust to the air from a point source. The premises must be maintained in a condition which minimises or prevents the emission of dust from the premises.
P.J & J.M Harris Pty Ltd	General agricultural processing	Gorrell Avenue Bourke	15 km SSW	There are limits on the emissions of dust to the air from two point sources. The premises must be maintained in a condition which minimises or prevents the emission of dust from the premises.

Additional industries existing in the local area may operate below the activity threshold specified for the relevant industry type, and hence do not need to report under the NPI program. Sources that potentially fall under this category may still constitute a constraint to the development of surrounding incompatible land uses, but on a smaller scale than those required to report under the NPI program.

The above findings demonstrate the predominately agricultural nature of the area.

5.2 Review of Available Ambient Air Quality Data

The township of Bourke is located approximately 800 km north-west of Sydney on flat terrain on the south bank of the Darling River. The population of Bourke was approximately 2,047 as of the 2011 census. There is no air quality monitoring station (AQMS) in operation in the township of Bourke. **Table 12** lists the closest NSW OEH's AQMS to the township of Bourke.

Selection of a representative AQMS can provide some indication of the background air quality being experienced at Bourke. Local air quality can be influenced by population, surrounding industries, meteorological conditions and terrain. These factors have been compared for each location to assess the suitability of the monitoring stations listed in **Table 12** for estimating conditions at Bourke as follows:

- Bulga has a much smaller population than Bourke, is surrounded by undulating terrain and lists coal mining as its major industry. The PM₁₀ concentrations surrounding Bulga are unlikely to represent the local air quality in Bourke.
- Wagga Wagga is NSW's largest inland city and is an important agricultural, military and transport hub. Given the much larger population and predominance of transport-related activities, it is unlikely air quality in Wagga Wagga would be representative of Bourke.
- Bathurst is located on the western edge of the Great Dividing Range adjacent to the Macquarie River. Mount Panorama is located 3 km from the CBD. Given the terrain features, it is likely that mountain and valley breezes form part of the local meteorology and aid in dispersion of pollutants.
- Similar to Bourke, Tamworth lies within its own airshed, with no significant other urban centres nearby. In addition, there are no significant industrial sources of pollution in the region, however the prevalence of wood heating leads to high PM₁₀ concentrations during the winter months. While the population of Tamworth is considerably larger than Bourke, it is considered to be the most representative AQMS, yet is still expected to provide a conservative estimate of the background air quality of Bourke.

Table 12 Closest Air Quality Monitoring Stations

Monitoring Station	Distance and Direction from Project site	Estimated Population
Bulga AQMS	560 km / SE	358
Wagga Wagga AQMS	555 km / SSE	67,364
Bathurst AQMS	500 km / SE	41,682
Tamworth AQMS	480 km / ESE	36,131

Background air quality data for PM₁₀ has been provided for Tamworth AQMS. This station is located approximately 480 km east south-east of the Project site and measures particulate concentrations (PM₁₀) but other pollutants such as CO, SO₂ or NO₂ are not measured. The Office of Environment and Heritage (OEH) note on their website¹ that monitoring data from Sydney and Newcastle regions allows screening of SO₂ and NO₂ and therefore monitoring of these parameters is not required in this region. No monitoring of CO is proposed in Tamworth at this stage.

The Tamworth AQMS was commissioned in October 2000 and is centrally located approximately 2 km to the south of the city centre and within the urban area. The site location is relatively low lying and will receive emissions of wood smoke in overnight, cold air drainage flows towards the Peel River.

Figure 9 below shows PM₁₀ levels measured at Tamworth AQMS for the years 2010 to 2014. The data indicate that 24-hour average PM₁₀ concentrations in the region typically range between 5 µg/m³ to 30 µg/m³. A small number of exceedances of the NSW EPA 24-hour average guideline of 50 µg/m³ have been recorded with one exceedance measured during each of the years 2011, 2012 and 2014. The maximum concentrations recorded in each year are summarised in **Table 13**.

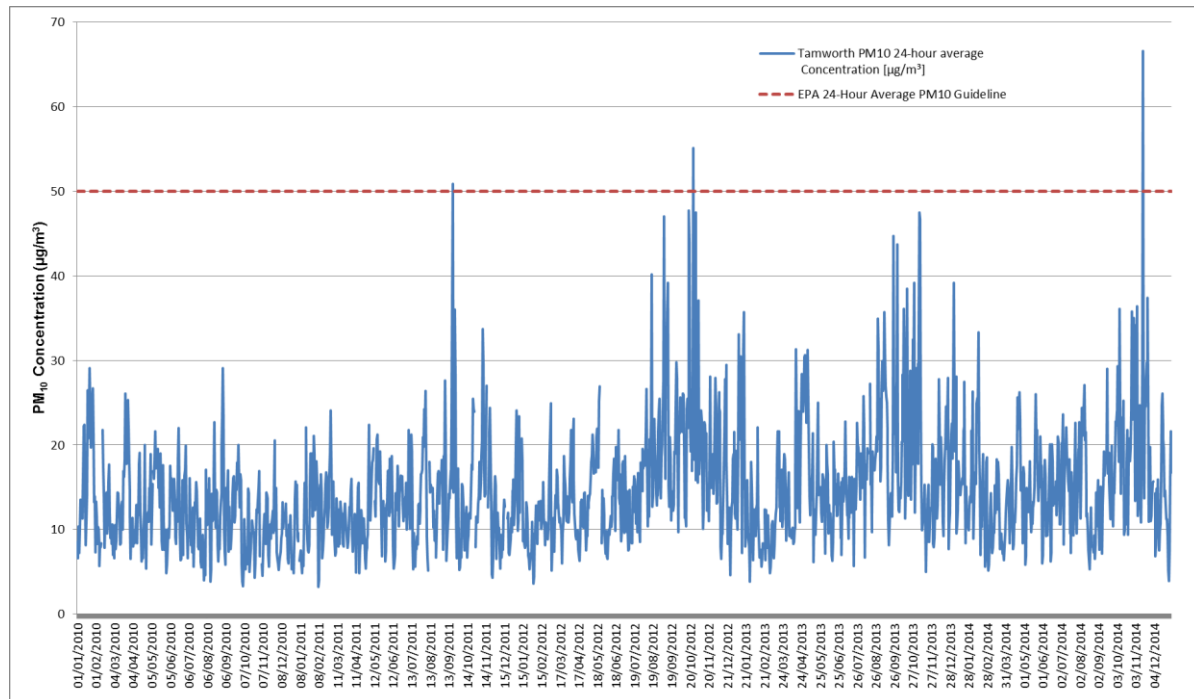
The annual average PM₁₀ concentrations recorded by the Tamworth AQMS are also shown in **Table 13**. The annual average PM₁₀ concentrations measured at Tamworth represent 40% to 55% of the NSW EPA guideline of 30 µg/m³.

Table 13 24-hour and Annual Average PM₁₀ Concentrations Measured in Tamworth, 2010 – 2014

Year	24-Hour Average PM ₁₀ Concentrations (µg/m ³)		Annual Average PM ₁₀ Concentration (µg/m ³)
	Maximum	Number of Exceedances	
2010	29.1	-	12.0
2011	50.9	1	13.1
2012	55.1	1	15.9
2013	47.5	-	16.6
2014	66.6	1	15.8
Criteria	50		30

¹ <http://www.environment.nsw.gov.au/air/nepm/304tamworth.htm>

Figure 9 24-Hour Average PM₁₀ Concentrations for the Region, 2010 – 2014



5.3 Background Concentrations Assumed for use in this Assessment

Modelling of operational emissions has been performed for PM₁₀, NO_x and odour. In order to be able to assess the potential cumulative impact of these emissions, an estimate of background concentrations must be performed so that they can be added to the incremental impacts predicted for the Project.

For air quality impact assessment purposes, it is standard practice to use background monitoring datasets taken from the same year as the meteorological dataset chosen for use in the dispersion modelling assessment. However, Tamworth is a more urbanised area than Bourke and the background concentrations are likely to be elevated, especially as the monitoring site location is relatively low lying and will receive emissions of wood smoke in overnight, cold air drainage flows towards the Peel River.

Therefore in order to provide a conservative, yet realistic assessment of background PM₁₀ concentrations, the average of the maximum 24-hour concentrations and annual average concentrations measured at Tamworth over the 2010 – 2014 period reviewed has been used. The background concentrations used are therefore as follows:

- A 24-hour average background PM₁₀ concentration of 49.8 µg/m³.
- An annual average background PM₁₀ concentration of 14.7 µg/m³.

The background level of NO_x as NO₂ has been assumed to be negligible given the lack of contributing industries in the immediate area. In addition, this assessment has assumed that all NO_x emissions are in the form of NO₂, which is a conservative assumption that would account for any residual background concentration of NO_x.

The background level of odour has also been assumed to be negligible given the lack of contributing industries in the immediate area (**Section 5**).

6 CONSTRUCTION PHASE AIR QUALITY IMPACTS

A qualitative risk-based assessment has been performed to assess the potential for adverse impacts on air quality at sensitive receptor locations during the construction phase. The full risk assessment methodology is detailed in **Appendix B**. The overall approach is described below.

6.1 Overview

Predictions of air quality impacts are necessary when appraising potential future impacts on potentially sensitive land uses. Sensitive receptors (e.g. residences) have been identified through site-based investigations and are outlined in **Table 2**. Construction activities proposed as part of the Project and having the potential to generate air pollution have been confirmed in consultation with CAPRA and are outlined in **Section 2.6** and **Section 3.1.1**.

Using the above information and taking into consideration local weather characteristics (refer to **Section 2.1.4**) and natural shelters (e.g. vegetated buffers and terrain), a qualitative risk-based impact assessment of potential air quality impacts on surrounding receptors has been performed to identify a range of suitable control measures available to mitigate those impacts. The methodology adopted for this risk-based assessment (see **Appendix B**) has been adapted from UK guidance presented in the Institute of Air Quality Management (IAQM) document, *Guidance on the assessment of dust from demolition and construction* (February 2014). (IAQM, 2014)

The IAQM method uses a four step process for assessing dust impacts from construction activities:

- Step 1: Screening based on distance to nearest receptor.
- Step 2: Assess risk of dust effects from activities based on:
 - the scale and nature of the works, which determines the potential dust emission magnitude; and
 - the sensitivity of the area.
- Step 3: Determine site-specific mitigation for remaining activities with greater than negligible effects.
- Step 4: Assess significance of remaining activities after mitigation has been considered.

It is noted that the adopted methodology is designed to provide an overall impact risk, and is not the defining determination for the requirement for mitigation and control. Impacts with a lower determined risk should also be minimised wherever possible. The approach may also underestimate the impact risk in environments which are assessed as having low sensitivity to impacts of a high magnitude, and therefore a pragmatic approach to the assessment should be applied. Any impacts identified as having a high risk should receive detailed appraisal of mitigation options.

6.2 Risk Assessment

6.2.1 Step 1 - Screening Assessment

All residential receptors identified in the vicinity of the Project are located greater than 350 m from the boundary of the site, are greater than 50 m from roads used by construction traffic, and are more than 500 m from the site entrance. According to the IAQM methodology outlined in **Appendix B**, receptors which meet these screening criteria do not require further assessment.

As the receptors are located at such a distance from the Project site that they meet the screening criteria, this indicates that there is a *negligible risk* of adverse air quality impacts occurring at these receptor locations, even if no mitigation was to be applied during the construction activities.

A negligible level risk rating does not preclude the requirement for suitable mitigation measures to be implemented during construction. The following section provides a range of appropriate mitigation measures that should be applied during the construction to ensure that all risks are minimised where ever practicable.

6.3 Construction Phase Mitigation Measures

6.3.1 Nuisance Dust Control Measures

Ambient dust emissions from wheel-generated dust, excavation and rehabilitation, demolition, clearing and grading, truck loading and unloading, and wind erosion areas will be the primary focus of dust control during construction works at the Project site. Typically, emissions from these processes can be minimised through the implementation of water spraying, particularly during periods of heavy on-site activity.

Dust mitigation measures that may be implemented during the construction phase include:

- Silt and other material be removed from around erosion and sediment control structures to ensure deposits do not become a dust source.
- Minimising the use of material stockpiles and ensuring sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.
- Ensuring vehicles entering/exit the site are covered to prevent escape of materials during transport.
- Reducing truck speeds on site to reduce wheel generated dust.
- If dirt track out is causing problems, avoiding dry sweeping of large areas. Manual brushing of the truck's flanks and wheels could be implemented as a further precaution.

6.3.2 Plant and Machinery

Control measures relating to plant and machinery that may be implemented during the construction phase include:

- Ensuring vehicles and machinery are maintained in accordance with manufacturer's specifications.
- Minimising truck queuing and unnecessary trips through logistical planning of materials delivery and work practices.
- Ensure all vehicles switch off engines when stationary so that there are no idling vehicles.

6.3.3 Contaminated Soils

The risk of encountering contaminated soils at this site is understood to be very low. Where there is the potential for invasive ground works to cause the emission of odorous ground vapour or contaminated dust particles an odour assessment and management procedure developed to manage the risks of off-site odour impacts and/or health impacts from the volatilisation of ground contaminants.

6.3.4 Site Management

Air emissions associated with all construction activities should also be managed on-site in the following manner:

- The works are conducted in a manner that minimises the generation of air emissions.
- The effectiveness of the controls being implemented is monitored.
- Additional measures are implemented where required.

Construction contractors should also undertake daily environmental inspections of their works and worksite. The daily environmental inspection reports should include the below observations, with remedial or corrective actions noted (as appropriate).

Any remedial or corrective actions should be reported to the Site Manager as soon as is practicable. Inspections may include, but not be limited to:

- Visual inspection of dust generation.
- Ensure roads leaving the site are free of soil, and prevention of soil tracking onto the road network.
- Inspection of the erosion and sediment controls.
- Inspection of the waste storage areas.
- Ensure all hazardous goods, including fuel and oil, are adequately stored or banded.
- Ensure spill kits are appropriately located and stocked.

6.3.5 Complaints Handling

An effective complaints logging system should be maintained by Council in conjunction with the Construction Contractor. This will allow for effective management of any requests for information, response to any public concerns in relation to the proposed redevelopment activities throughout the construction phase, and to ensure identified incidents are dealt with through investigation and implementation of corrective treatments.

7 OPERATIONAL PHASE AIR QUALITY IMPACTS

The key air emissions associated with the operational phase of the Project are products of combustion (NO_x and PM_{10}) from the gas-fired steam boilers and odour emissions from the holding pens, processing areas and wastewater treatment plant. Minor emissions of particulate matter will also occur as a result of vehicle movements on the unsealed roads within the site. It is not possible to accurately estimate these emissions however, and the low traffic numbers mean that they should be easily controlled through appropriate mitigation measures such as maintenance of the road surface and speed restrictions. The modelling study therefore focuses on PM_{10} emissions from the boilers only.

This section summarises the methodology, input data and assumptions used to estimate these emissions and to model their dispersion off-site.

7.1 Modelling Methodology

The dispersion modelling methodology used for this assessment included the use of the TAPM, CALMET and CALPUFF models.

7.1.1 Dispersion Modelling - CALPUFF

CALPUFF (Scire, et al., 2000) is a multi-layer, multi-species, non-steady state puff dispersion model that can simulate the effects of time and space varying meteorological conditions on emissions transport, transformation and removal. The model contains algorithms for near-source effects such as building downwash, partial plume penetration, sub-grid scale interactions as well as longer-range effects such as substance removal, chemical transformation, vertical wind shear and coastal interaction effects. The model uses dispersion equations based on a Gaussian distribution of substances across the puff and takes into account the complex arrangement of emissions from point, area, volume, and line sources.

CALPUFF requires inputs in three major areas:

- Emission rates and source details (refer **Section 7.2**);
- Meteorology (refer **Sections 7.1.2, 7.1.3 and 7.1.4**); and
- Terrain and surface details, as well as specification of specific receptor locations (refer **Sections 2.1.2 and 2.1.3**).

7.1.2 Meteorological Modelling Methodology

7.1.2.1 TAPM

Meteorological data was prepared for the dispersion modelling using The Air Pollution Model (TAPM) developed by CSIRO. TAPM v4 solves the fundamental fluid dynamics and scalar transport equations to predict meteorology and (optionally) pollutant concentrations. It consists of coupled prognostic meteorological and air pollution concentration components. The model predicts airflow important to local scale air pollution, such as sea breezes and terrain induced flows, against a background of larger scale meteorology provided by synoptic analyses. Detailed description of the TAPM model and its performance is provided elsewhere. The Technical Paper by Hurley (2008a) describes technical details of the model equations, parameterisations, and numerical methods. A summary of some verification studies using TAPM is also given in Hurley (2008b).

TAPM v4 has a tendency to overpredict the incidence of light winds in some situations. However, this tendency is considered to lend a conservative bias as low wind speeds are conducive to higher ground level concentrations.

7.1.2.2 CALTAPM

CALTAPM was developed to provide users of the TAPM model the ability to create an hourly, 3-dimensional data file of gridded meteorological parameters of the type 3D.DAT for direct use in the CALMET diagnostic meteorological model. When used this way the TAPM data can be used in CALMET to determine the initial guess wind field, prior to the weighting of true observations or even to run CALMET in no-observation mode. The TAPM output file was converted to a 3D.DAT file using CALTAPM for input into CALMET as an initial guess wind field.

7.1.2.3 CALMET

CALMET is a meteorological pre-processor that includes a wind field generator containing objective analysis and parameterised treatments of slope flows, terrain effects and terrain blocking effects. The pre-processor produces fields of wind components, air temperature, relative humidity, mixing height and other micro-meteorological variables to produce the three-dimensional meteorological fields that are used in the CALPUFF dispersion model.

CALMET requires several datasets in order to resolve the surface and upper air meteorology occurring for each hour of the year:

- Surface observations:
 - Wind speed;
 - Temperature;
 - Cloud cover amount;
 - Precipitation amount and type; and
 - Base cloud height.
- Upper air observations:
 - Height of observation;
 - Wind speed and direction at each height;
 - Temperature at each height; and
 - Barometric pressure at each height.
- Land Use data; and
- Topographical data.

CALMET was run with surface observations from the Bourke Airport AWS and Cobar MO. The inner model domain used in the CALMET model encompassed a 12.5 x 12.5 km grid with 0.125 km resolution and was referenced to a south-west corner of 396,555, 6,677,910 m. A 3D.DAT file generated by CALTAPM was used as an initial guess wind field for the meteorological modelling of the outer grid. Subsequent CALMET model domains used the previous CALMET output file as an initial guess wind field.

The settings outlined in **Table 14** were used in the CALMET setup. A large outer model domain was set up to enable the observed meteorological data at Cobar MO to be included in the meteorological modelling. Running CALMET in this manner then requires subsequent model domains to have grid points of no more than 50 in both X and Y directions and grid resolutions less than or equal to a factor of 4. Given there are few meteorological stations close to the Project site, it was decided to include all possible meteorological information to obtain the most accurate model output. Unfortunately, this precludes the ability to use meteorological data not incorporated into the model to perform a full verification of the meteorological model output. **Section 7.1.4** highlights how the meteorological outputs are conservative and appropriate for using to predict dispersion of pollutants.

Table 14 CALMET Configuration Used for this Study

Modelling Period	1 January 2012 to 31 December 2012
Centre of analysis	402,805 mE 6,684,160 mN (UTM Coordinates)
Meteorological grid domain (Meteorological grid resolution)	360 km x 360 km (7.2 km) 90 km x 90 km (1.8 km) 22.5 km x 22.5 km (0.45 km) 12.5 km x 12.5 km (0.125 km)
Vertical Resolution (Cell Heights)	10 (0 m, 20 m, 40 m, 80 m, 160 m, 320 m, 640 m, 1200 m, 2000 m, 3000 m, 4000 m)
Data Assimilation (in outer grid only)	Bourke Airport AWS (Station #048245) Cobar MO (Station #048027)

7.1.3 Selection of Representative Meteorological Data

In dispersion modelling, one of the key considerations is the representativeness of the meteorological data used. Once emitted to atmosphere, emissions will:

- Rise according to the velocity and temperature at the point of emission;
- Be advected from the source according to the strength and direction of the wind at the height which the plume has risen in the atmosphere;
- Be diluted due to mixing with the ambient air, according to the intensity of turbulence, and
- Possibly be chemically transformed and/or depleted by deposition processes.

Dispersion is the combined effect of these processes.

Dispersion modelling is used as a tool to simulate the air quality effects of specific emission sources, given the meteorology typical for a local area together with the expected emissions. Selection of a year when the meteorological data is atypical means that the resultant predictions may not appropriately represent air quality.

The year of meteorological data used for this assessment was selected by reviewing the most recent five years of historical surface observations at Bourke Airport AWS (2010 to 2014 inclusive) to determine the most representative year. Wind speed, ambient temperature and relative humidity were compared to long term averages for the region to determine the most representative year. The long term averages are available from 1998 – 2014 at 9 am and 3 pm.

Data collected from 2010 to 2014 is summarised in **Figure 10** to **Figure 15**. Examination of the data indicates the following:

- None of the 5 years of data appear to be outliers against the long term average.
- Low wind speeds are associated with less effective plume dispersion. Therefore, any year indicating higher than the longer term average wind speeds would provide less conservative model results. Of the 24 monthly wind speeds at 9 am and 3 pm presented in **Figure 10** and **Figure 11**, 2013 has 8 above the long term average. 2011 follows with 5 above the long term average, 2014 with 4 occurrences and 2012 with 2. The 3 pm January 2012 wind speed is the only occasion when 2012 data is higher than the long term average. Given that wind speed plays a significant role in dispersion, the selection of model year draws heavily on this result.
- 2010 and 2011 show higher than average relative humidity, especially in the summer months.

Using 2012 as the representative year would be a conservative approach because low wind speeds are associated with less effective plume dispersion. Consequently, 2012 was selected as a suitably representative year of meteorology.

Figure 10 Wind Speed at 9 am at Bourke Airport AWS (2010-2014)

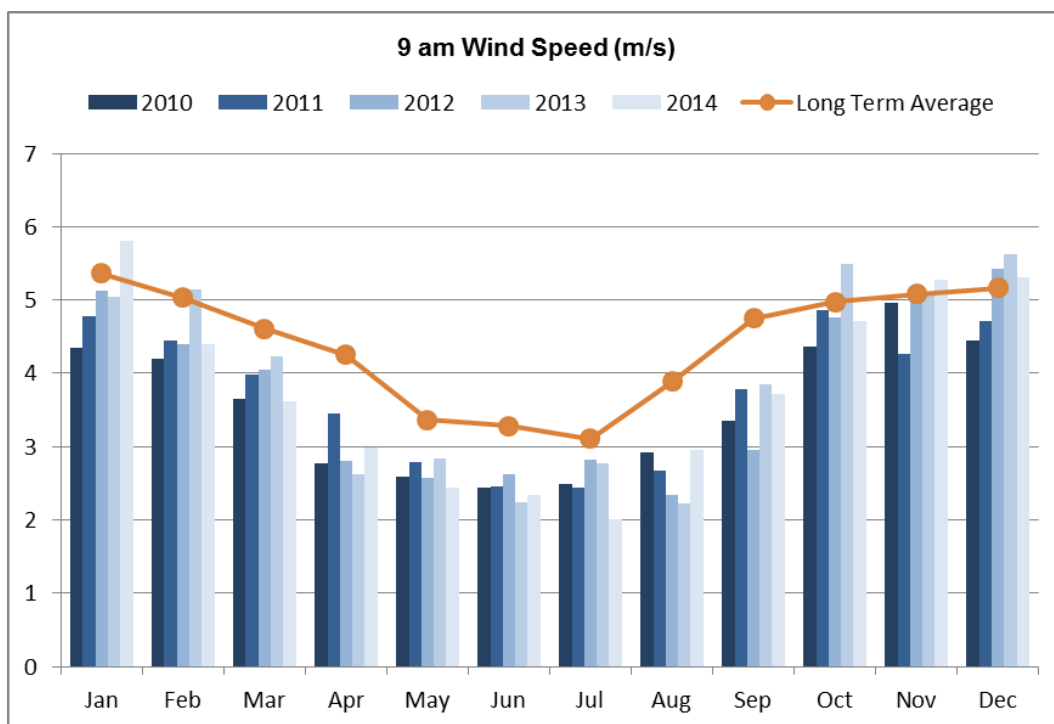


Figure 11 Wind Speed at 3 pm at Bourke Airport AWS (2010-2014)

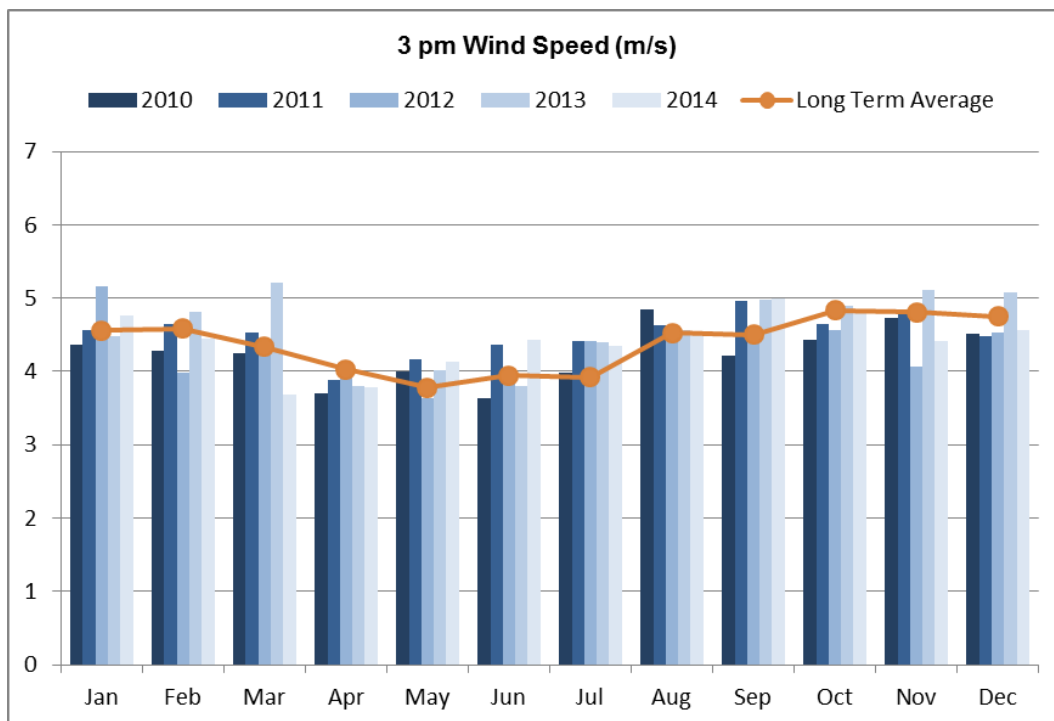


Figure 12 Temperature at 9 am at Bourke Airport AWS (2010-2014)

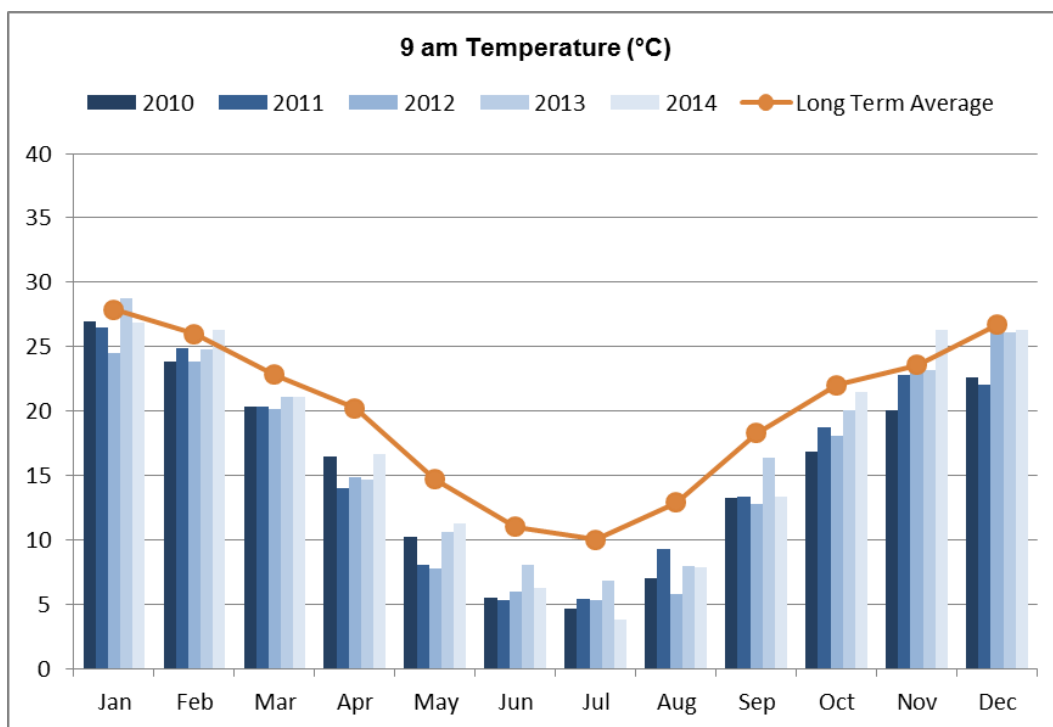


Figure 13 Temperature at 3 pm at Bourke Airport AWS (2010-2014)

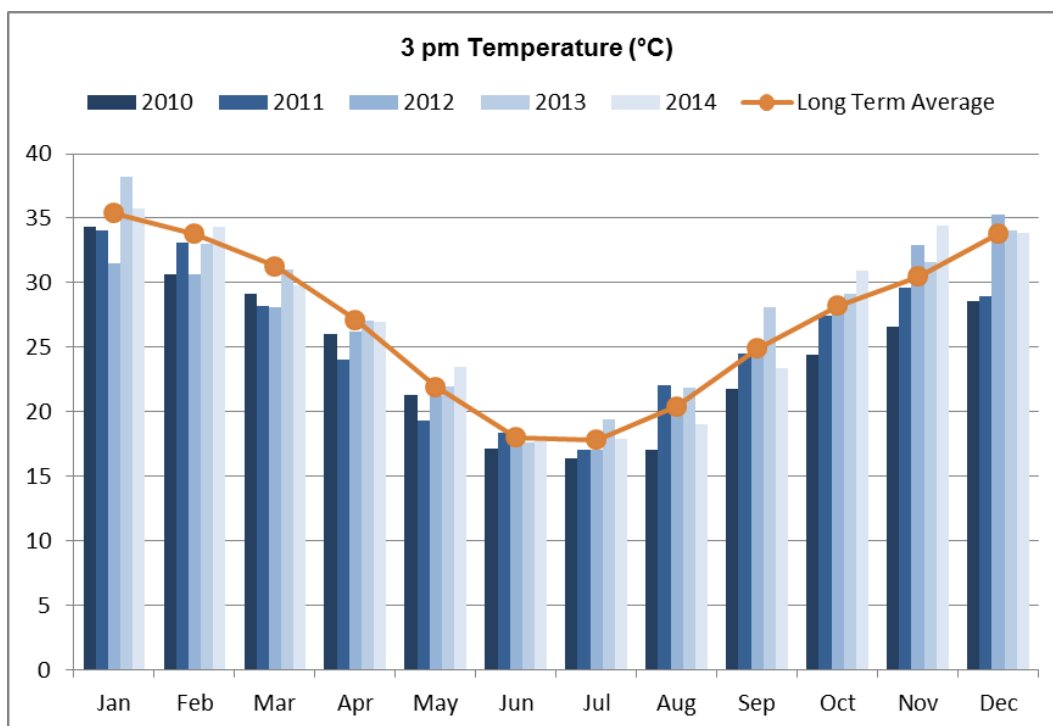


Figure 14 Relative Humidity at 9 am at Bourke Airport AWS (2010-2014)

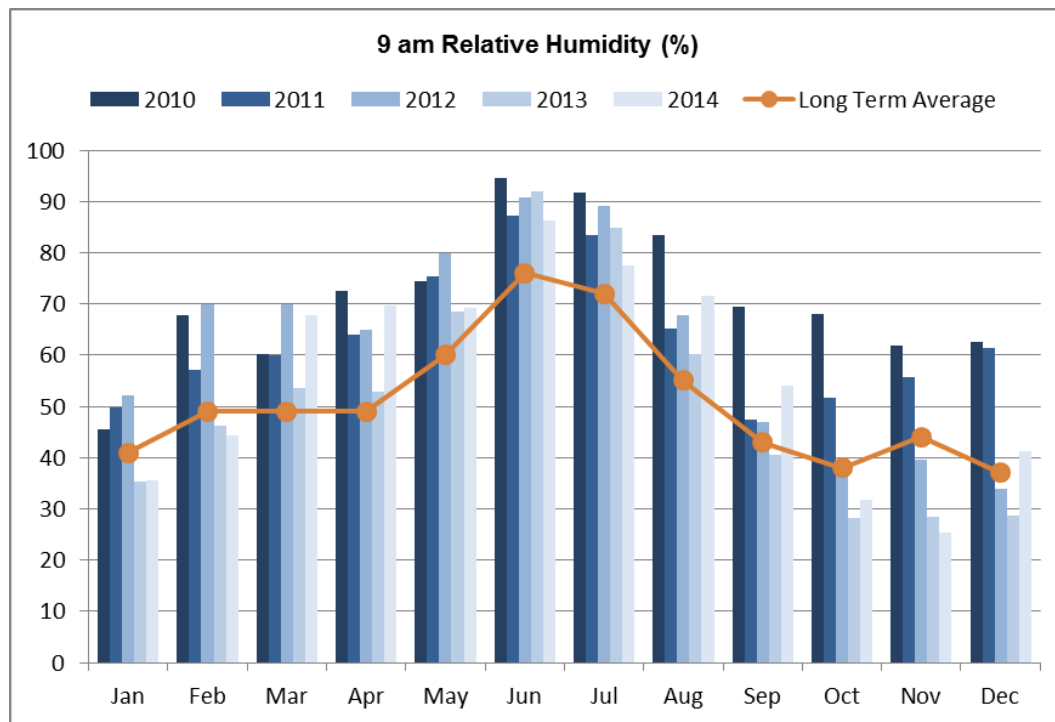
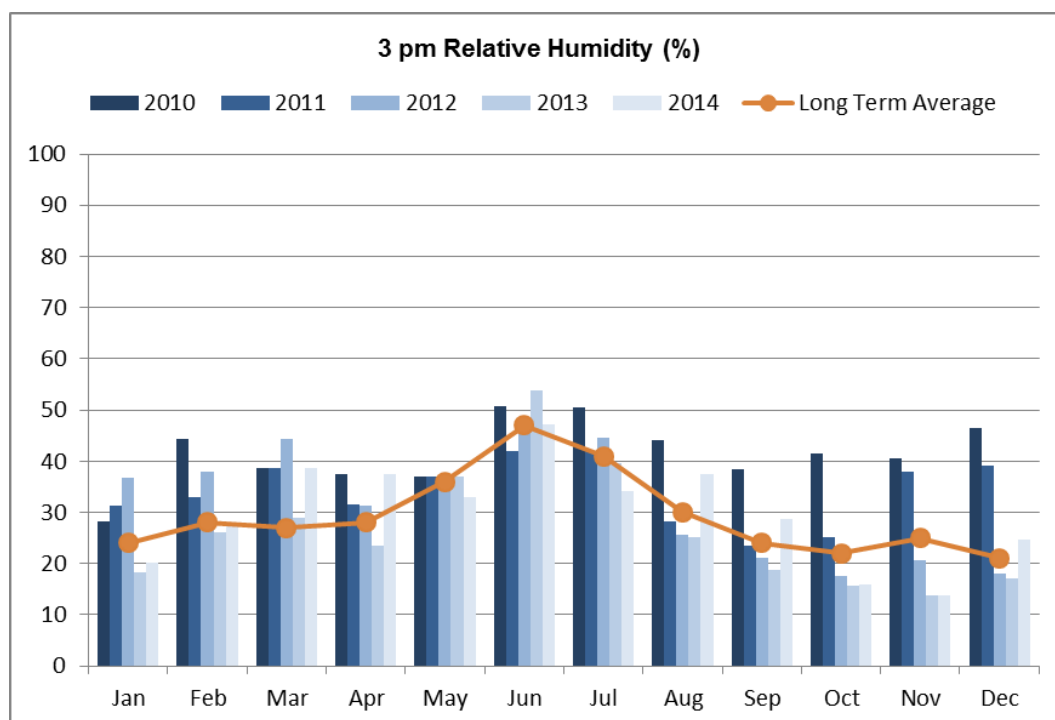


Figure 15 Relative Humidity at 3 pm at Bourke Airport AWS (2010-2014)



7.1.4 Meteorological Data Used in the Modelling Study

7.1.4.1 Wind Speed and Direction

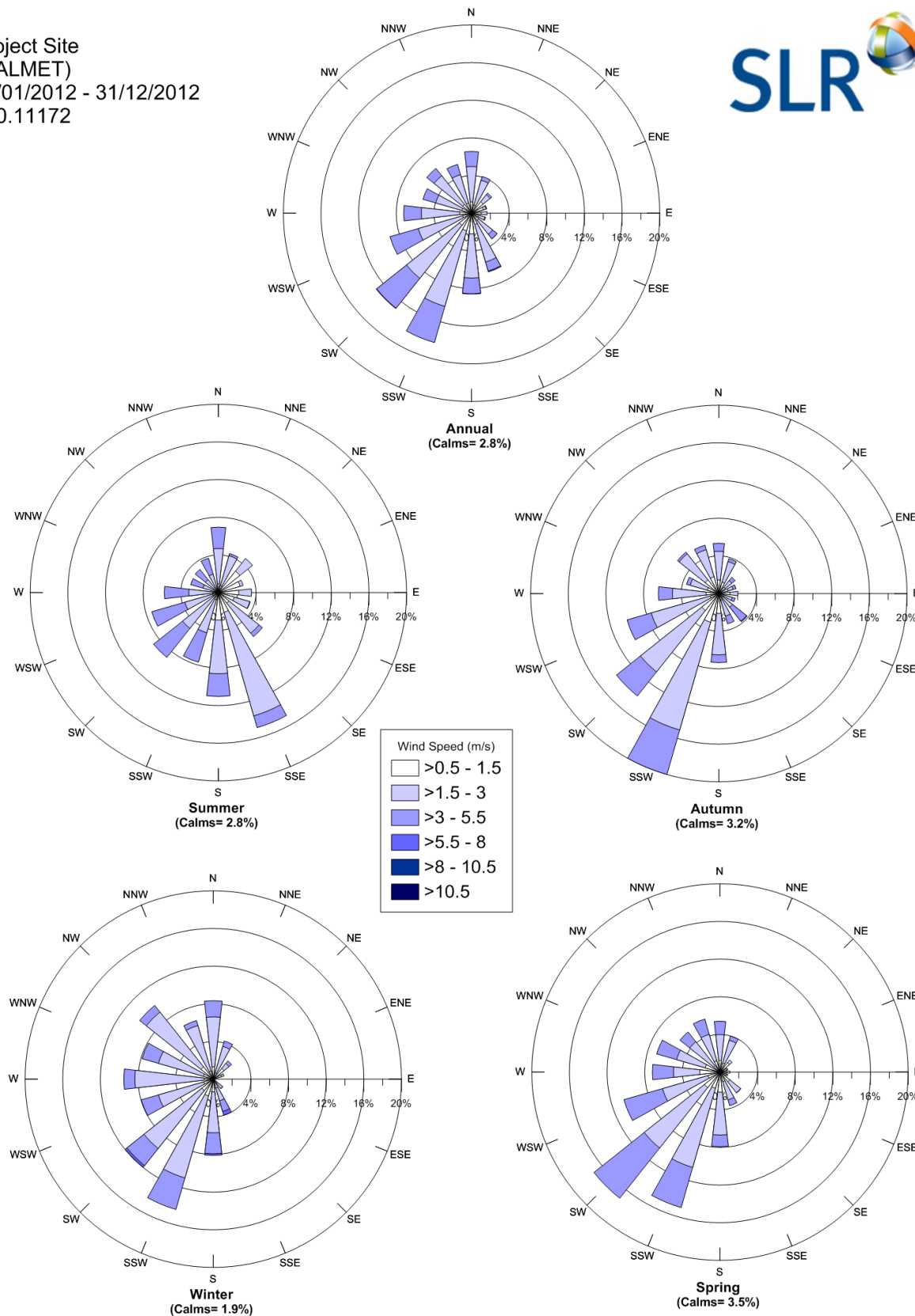
Figure 16 shows the annual and seasonal wind roses extracted (from the CALMET generated data) for the Project site. The predominant wind directions predicted at the Project Site on an annual basis are in the southwesterly quadrant. South-southeasterly winds dominate in summer and tend south-southwesterly in the autumn. The cooler months show a significant percentage of winds from the west and southwest. Dominant spring winds were predicted to originate from the southwest.

The CALMET generated data showed an annual average wind speed of 2.3 m/s and calm conditions occurring approximately 2.8% of the time. Given the annual percentage of calms observed at Bourke Airport AWS was 2.2% for 2012 the prediction of 2.8% calms is conservatively increasing the frequency of calm events in the model. This leads to an increase in the wind conditions that lead to poor dispersion in the model.

Winds from the north are predicted to occur infrequently however there are a higher percentage of northerly (6-7%) and north-northeasterly (4%) winds predicted by the model than observed at the Bourke Airport AWS (see **Section 2.1.4.1**). Based on this it can be concluded that there is low potential for air emissions from the Project to be dispersed towards the nearest sensitive receptors but the model predicts these wind conditions more frequently than they are observed, providing a conservative assessment of impacts.

Figure 16 CALMET Generated Wind Roses for the Project Site

Project Site
(CALMET)
01/01/2012 - 31/12/2012
640.11172



7.1.4.2 Stability Class

Atmospheric stability refers to the tendency of the atmosphere to resist or enhance vertical motion. The Pasquill-Turner assignment scheme identifies six Stability Classes, A to F, to categorise the degree of atmospheric stability as follows:

- A = Extremely unstable conditions
- B = Moderately unstable conditions
- C = Slightly unstable conditions
- D = Neutral conditions
- E = Slightly stable conditions
- F = Moderately stable conditions

The meteorological conditions defining each Pasquill stability class (Pasquill, 1961) are shown in **Table 15**.

Table 15 Meteorological Conditions Defining Pasquill Stability Classes

Surface wind speed (m/s)	Daytime insolation			Night-time conditions	
	Strong	Moderate	Slight	Thin overcast or > 4/8 low cloud	<= 4/8 cloudiness
< 2	A	A - B	B	E	F
2 - 3	A - B	B	C	E	F
3 - 5	B	B - C	C	D	E
5 - 6	C	C - D	D	D	D
> 6	C	D	D	D	D

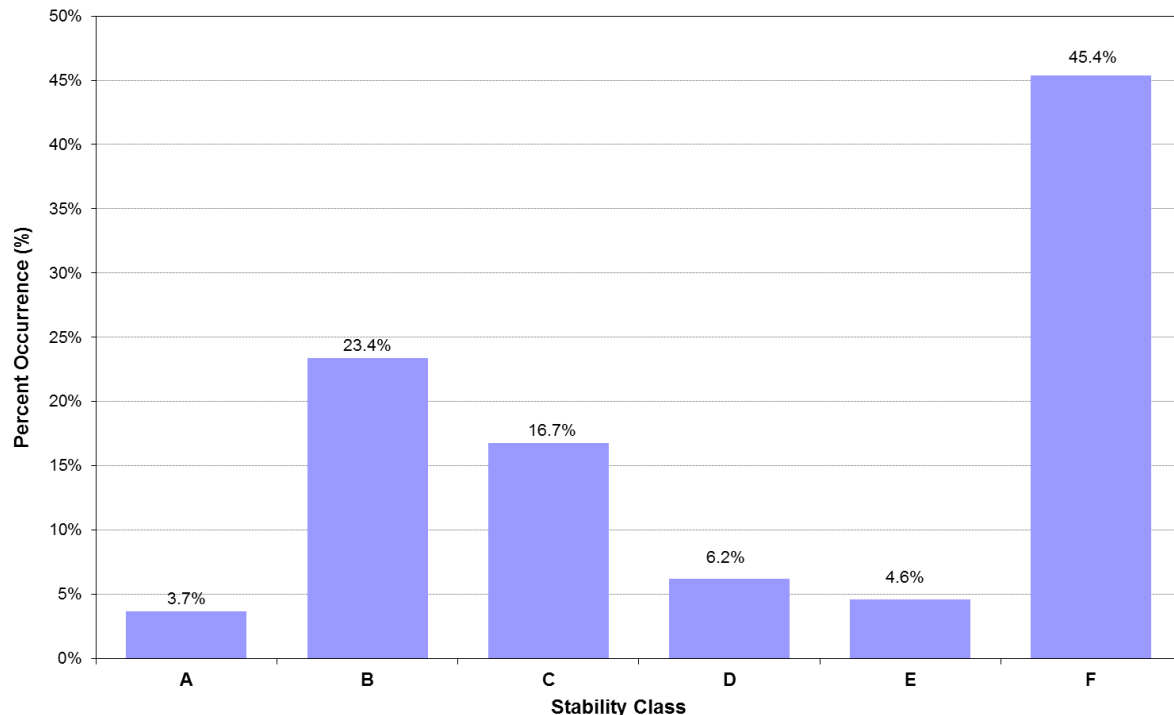
Notes:

1. Strong insolation corresponds to sunny midday in midsummer in England; slight insolation to similar conditions in midwinter.
2. Night refers to the period from 1 hour before sunset to 1 hour after sunrise.
3. The neutral category D should also be used, regardless of wind speed, for overcast conditions during day or night and for any sky conditions during the hour preceding or following night as defined above.

The CALMET-generated meteorological data can be used to estimate stability classes and the frequency distribution of estimated stability classes is presented in **Figure 17**. The data show a high proportion of moderately unstable (class B) and night time stable conditions (class F). The high frequency of Class F conditions are due to the high number of hours per day where these conditions dominate (starting at sunset, progressing throughout the night and concluding after sunrise). The amount of turbulence in the atmosphere has a major effect on the dispersion because turbulence increases the entrainment and mixing. This high precedence of stable conditions represents the worst case for dispersion and will result in a conservative assessment.

It is noted that a turbulence based scheme within CALPUFF was used in the modelling and the P-G stability class frequency is shown for information only.

Figure 17 Frequency Distribution of Stability Classes at the Project Site



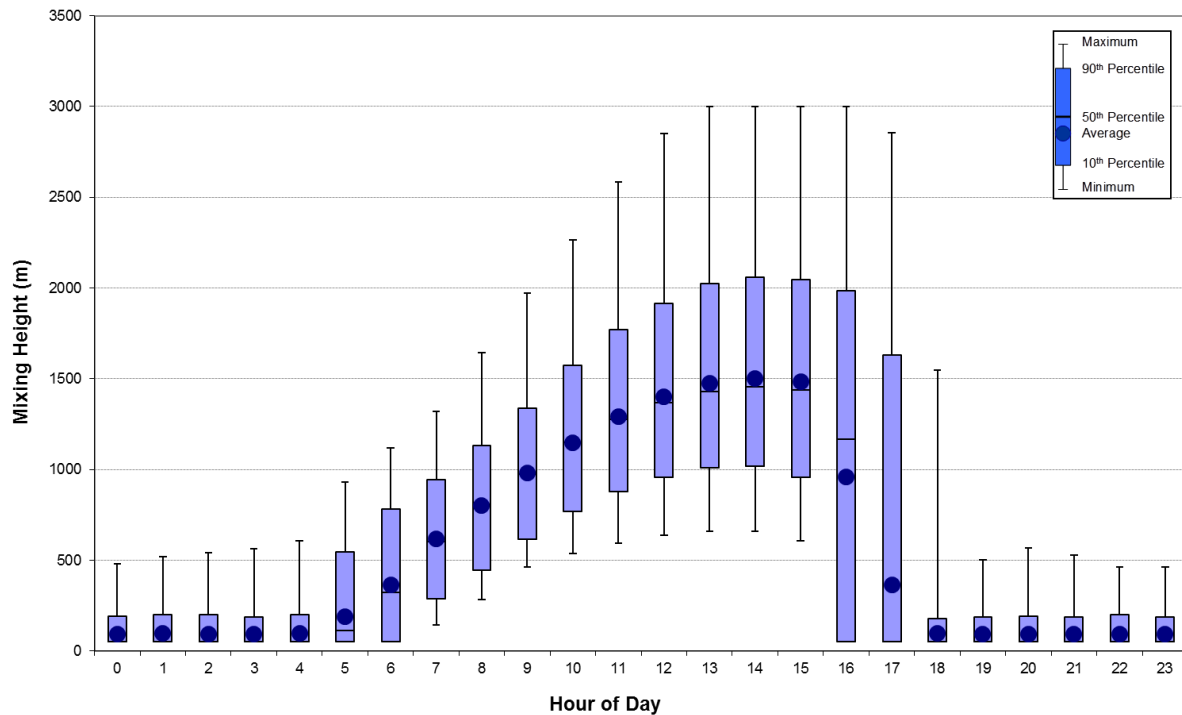
7.1.4.3 Mixing Height

Mixing height is defined as the height above ground of a temperature inversion or statically stable layer of air capping the atmospheric boundary layer. It is an important parameter within air pollution meteorology as vertical diffusion or mixing of a plume is generally considered to be limited by the mixing height, as the air above this layer tends to be stable, with restricted vertical motion.

The mixing height is often associated with, or measured by, a sharp increase of temperature with height, a sharp decrease of water-vapour, a sharp decrease in turbulence intensity and a sharp decrease in pollutant concentration. Mixing height is variable in space and time, and typically increases during fair-weather daytime conditions over land from tens to hundreds of metres around sunrise up to 1-3 km in the mid-afternoon, depending on the location, season and day-to-day weather conditions.

Mixing heights show diurnal variation and can change rapidly after sunrise and at sunset. Diurnal variations in the minimum, maximum and average mixing depths, based on the CALMET-generated meteorological data extracted at the Project Site, are shown in **Figure 18**. As expected, mixing heights begin to grow following sunrise with the onset of vertical convective mixing with maximum heights reached in mid to late afternoon. The median, highest and lowest mixing heights for each hour are represented by the horizontal lines. The vertical bars represent the lower quartile and upper quartile of mixing heights. The dark blue points represent the average.

Figure 18 Mixing Heights at the Project Site



7.2 Emissions Estimation

The potential air emission sources identified for the operational phase of the Project are discussed in **Section 3.1.2**. The source characteristics and estimated emission rates for these sources are detailed in **Table 16** and **Table 17**.

The source locations and base elevations have been taken from site layout plans provided by CAPRA. The basis of the emission estimates for each source is provided as footnotes to the tables.

Table 16 Source Characteristics and Estimated Emissions - Boilers

Source ID	Operation	Base Elevation	Source Coordinates (m, GDA94 Zone 55s)		Release Height	Stack Diameter	Exhaust Temp	Exhaust flowrate	Exhaust Velocity	NO _x	Total PM (as PM ₁₀)
		m	X	Y	(m)	(m)	(K)	(m ³ /s)	(m/s)	(g/s)	(g/s)
SRC_1	Boiler ¹	112.45	403,033	6,684,124	8	0.4	513	2.89 ²	23	0.315 ³	0.031 ⁴
SRC_2	Boiler ¹	112.42	403,033	6,684,122	8	0.4	513	2.89 ²	23	0.315 ³	0.031 ⁴

Notes:

1. Boilers to be fuelled by natural gas hence SO₂ concentrations will be negligible.
2. Exhaust flow rate has been based on a stack diameter of 0.7 m and a nominal velocity of 15 m/s to give 5.77 m³/s (East Coast Steam Pty Ltd, 2014). This total gas flow was then split between two stacks (one for each boiler) with a stack diameter of 0.4 m each, to give an exhaust velocity of 23 m/s and flowrate of 2.89 m³/s.
3. NO_x concentration of 50 ppm per boiler was discharged from the low NO_x burners.
4. The PM₁₀ emission rate was calculated by multiplying the flowrate (2.89 m³/s) by the in-stack PM₁₀ concentration reported for the Fonterra boilers described in the Fonterra Spreyton Facility assessment (0.0107 g/m³). This was derived from an emission rate of 0.042 g/s and a flowrate of 3.927 m³/s (PAEHolmes, 2011).

Table 17 Source Characteristics and Estimated Emissions - Odour Sources

Source ID	Operation	Base Elevation	Source Dimension (m)		Area	Source Coordinates (m, GDA94 Zone 55s)		Release Height	σY	σZ	Specific Odour Emission Rate ⁸
		m	Length	Width	m ²	X	Y	(m)			(OU.m ³ /m ² /s)
SRC_5 ¹	Primary Holding Pen (manure)	111.99	135	60	8,100	403,050	6,684,130	2	-	0.47	1.81
SRC_15 ²	Secondary Holding Pen (manure)	112.06	60	30	1,800	403,045	6,684,259	1	-	0.23	0.35
SRC_16 ³	Primary Holding Pen (goat odour)	111.99	135	60	8,100	403,050	6,684,130	2	-	0.47	47.0
SRC_17 ³	Secondary Holding Pen (goat odour)	112.06	60	30	1,800	403,045	6,684,259	1	-	0.23	47.0
SRC_3 ⁴	Kill Floor	112.22	2	2	4	403,106	6,684,119	2	0.47	0.47	0.53
SRC_4 ⁵	Non-edible	112.13	1	1	1	403,083	6,684,118	2	0.23	0.23	15.8
SRC_6 ⁵	Skins	112.16	1	1	1	403,072	6,684,121	1	0.23	0.47	15.8
SRC_7 ⁵	Paunch	112.16	1	1	1	403,075	6,684,113	1	0.23	0.47	15.8
SRC_8 ⁶	Rotary Screen	112.67	1	1	1	402,909	6,684,350	1	0.23	0.47	8.33
SRC_9 ⁵	Waste from screen bin	112.67	1	1	1	402,909	6,684,354	1	0.23	0.47	15.8
SRC_10 ⁷	DAF	112.62			28.27	402,912	6,684,361	2	-	0.47	2.73
SRC_11 ⁸	Wastewater treatment pond 1	112.94	100	100	10,000	402,728	6,684,550	0	-	0.23	3.38
SRC_12 ⁸	Wastewater treatment pond 2	112.79	100	100	10,000	402,833	6,684,531	0	-	0.23	3.38
SRC_13 ⁸	Wastewater treatment pond 3	112.08	100	100	10,000	402,814	6,684,427	0	-	0.23	3.38
SRC_14 ⁸	Wastewater treatment pond 4	112.37	100	100	10,000	402,710	6,684,447	0		0.23	3.38

Notes:

1. Odour emission rates pertaining specifically to goat manure are not publically available in Australia. The maximum odour emission rate from 23 separately sourced literature values for holding pens has been used in this assessment. This OER was from soiled holding pens containing sheep. Odour emission rates taken in Australia from sheep manure were deemed to be appropriate.
2. As the secondary holding pen is to only be used periodically, a continuous emission rate from an unsoiled (clean but used) holding pen for sheep has been used for this assessment.
3. An odour emission rate of 47 OU.m³/m²/s (derived from 42 OU.m³/s/goat with a goat density of 1.12 goats/m²) was used as a conservative assumption of goat odour. See **Section 7.4.3.1**.
4. Kill floor usually is not a major source of odour, a small emission rate has been added for conservatism. (Katestone Environmental, 2004).
5. This OER is the maximum OER available in the literature for fresh side products from the abattoir process. (Heggies, 2006).
6. OER is from a hot screen, which should be conservative. (Consulting Environmental Engineers, 2008).
7. This emission rate is the maximum OER of four emission rates found in the literature for DAFs. (Heggies, 2006).
8. This emission rate is the maximum OER of five emission rates found in the literature for anaerobic ponds. (The Odour Unit, 2007).
9. Peak to mean ratios relevant to the type of source modelled were applied to these emission rates, with a varying peak to mean ratio applied to area sources based on the stability class (**Section 4.1.6.1**)

7.3 Operational Phase Mitigation Measures

The emission estimates documented in **Section 7.2** have been sourced from facilities with published emission rates and where multiple measurements are available, the maximum measured rate has been assumed to be conservative. It is not possible to confirm if all of the facilities where the measurements were taken applied best practice mitigation measures to reduce odour. Therefore, it is possible that some of the emission rates applied will lead to an over-estimation of the odour concentration predicted by the model outside the site boundary.

The following best practice mitigation measures will be implemented during the operation of the Project to minimise the odour propagated from sources and activities:

- Regular cleaning of holding yards.
- Prompt removal of any potentially odour-generating material from site.
- Waste to be transported around the site in enclosed systems wherever possible.
- Proper operation of water treatment systems to avoid odour generation.
- Non-enclosed systems to be accessible for regular clean down.
- Traffic management procedures to co-ordinate the delivery schedule and avoid a queue of the incoming or outgoing trucks for extended periods of time.
- Spill management procedures to include immediate clean-up of any spill/leakage.
- Installation and operation of the boilers in accordance with manufacturer's instructions, including regular maintenance and tuning to minimise pollutant emissions and to optimise the fuel efficiency.
- Construction and maintenance of the unsealed access roads to minimise wheel-generated dust.
- Reducing truck speeds on site to reduce wheel-generated dust.
- Maintenance of an odour complaint logbook and, in the event of a complaint, immediate investigation of any unusual odour sources within the site boundary and appropriate action taken to eliminate these.

7.4 Modelling Results and Assessment of Impacts

7.4.1 Nitrogen Dioxide

Table 18 shows the annual average and maximum 1-hour NO₂ concentrations predicted at the sensitive receptors due to emissions from the gas fired boilers. It has conservatively been assumed that there is full oxidation of the NO_x to NO₂ whereas in reality, it is more likely to be approximately 20% - 40% at the sensitive receptor locations. These predictions are therefore considered to overestimate actual downwind NO₂ concentrations.

Concentration contours of the predicted model results are presented in **Figure 19** and **Figure 20** in **Appendix C**. The predicted annual average NO₂ concentrations are less than 0.1 µg/m³ at either receptor, which is far below the 62 µg/m³ criterion. The maximum 1-hour average NO₂ concentration of 5.9 µg/m³ was predicted at Receptor 2 and is far below the 246 µg/m³ guideline.

Table 18 Predicted NO₂ Concentrations at Sensitive Receptors

Receptor ID	Coordinates (MGA, m)		NO _x as NO ₂ Annual Average (µg/m ³)	NO _x as NO ₂ Maximum 1-hour Average (µg/m ³)
	X	Y		
R1	401,381	6,678,643	<0.1	5.7
R2	401,453	6,678,340	<0.1	5.9
Guideline (µg/m³)			62	246

7.4.2 Particulate Matter

The annual average and maximum 24-hour average PM₁₀ concentrations predicted at the sensitive receptors due to emissions from the gas fired boilers are presented in **Table 19**, with and without the contribution from background air quality. Emissions of total particulate matter from the boilers were all modelled as PM₁₀ to provide a conservative approach. The background air quality contribution was sourced from the Tamworth air quality monitoring station (**Section 5.2**).

The concentration contours of the predicted model results are presented in **Figure 21** and **Figure 22** (exclusive of background), in **Appendix C**. The predicted annual average PM₁₀ concentrations reach a maximum of <0.1 µg/m³ at either receptor, which is below the 30 µg/m³ criterion. Inclusive of background air quality contributions of 14.7 µg/m³, the criterion is still met. The maximum 24-hour average PM₁₀ concentration of 0.13 µg/m³ was predicted at Receptor 1 and was predicted to be below the 50 µg/m³ guideline. With the background air quality contribution of 49.8 µg/m³, the appropriate criterion is met.

Table 19 PM₁₀ Concentrations Predicted at Sensitive Receptors

Receptor ID	Incremental		Background		Cumulative	
	Annual Average (µg/m ³)	24-hour Average (µg/m ³)	Annual Average (µg/m ³) ¹	24-hour Average (µg/m ³) ¹	Annual Average (µg/m ³)	24-hour Average (µg/m ³)
R1	<0.1	0.1	14.7	49.8	14.7	49.9
R2	<0.1	0.1	14.7	49.8	14.7	49.9
Guideline (µg/m³)	30	50	-	-	30	50

Notes:

1. Tamworth air quality monitoring station (**Section 5.3**)

The results are also far below the criteria shown in **Table 8** for PM_{2.5} hence these results demonstrate that even if all the PM emitted by the boilers is in the PM_{2.5} size fraction there would be no significant impact on off-site air quality.

7.4.3 Odour

The ground level odour concentrations predicted at the nearest representative receptors are summarised in **Table 20**. The 99th percentile of the predicted 1-second average ground level odour concentrations are presented with and without goat odour. Contour plots of these predictions are also shown as contour plots in **Figure 23** and **Figure 24** in **Appendix C**.

The level odour concentrations predicted including goat odour have utilised an odour emission rate of 47.04 OU.m³/m²/s. This has been estimated based on an emission factor of 42 OU.m³/s/goat, and the goat density of the proposed Project which is conservatively estimated to be 11,000 goats in 9,752 m² of holding pens. **Section 7.4.3.1** presents additional details on this emission rate, including the literature review conducted to identify possible goat emission rates, and how sensitive compliance with the 6.0 OU odour criterion is to the emission rate assumed for goat odour.

Table 20 Peak 1-Second Average (99th percentile) Odour Concentrations Predicted at Sensitive Receptors

Receptor ID	Coordinates (MGA, m)		Odour Concentration (99 th percentile, nose response time) (OU)	
	X	Y	All Sources except goat odour	All Sources including goat odour
R1	401,381	6,678,643	1.2	4.4
R2	401,453	6,678,340	1.1	4.4
Guideline (OU)			6.0	

Table 20 shows the predicted 99th percentile peak 1-second average odour concentrations for the proposed Project only. When the contribution from goats is excluded, Receptor 1 and 2 are predicted to be impacted by odour concentrations of just over 1 OU. 1 OU is considered the theoretical minimum concentration that produces an olfactory response or sensation in 50% of the population under laboratory conditions. The character of an odour usually cannot be determined at this concentration. An odour at a concentration of 1 OU is in reality so weak that it would not normally be detected outside the controlled environment of an odour laboratory by the majority of the population.

When the contribution from goats is included, the highest 99th percentile odour concentration predicted at Receptor 1 and 2 is 4.4 OU, which is below the impact assessment criterion of 6.0 OU. The UK *Odour Guidance for Local Authorities* (Department for Environment, Food and Rural Affairs, 2010) provides the following guidance as to when odour concentrations becomes apparent (derived from laboratory measurements of intensity):

- 1 OU is the detection threshold for odour (by definition);
- 5 OU is a typical concentration for a faint odour; and
- 10 OU is a typical concentration for a distinct odour.

Therefore, odours may be detected at this location but are unlikely to be of such an intensity to be recognised or considered offensive.

Maximum concentrations of odour generally tend to occur when meteorological conditions are least favourable for dispersion. These times of day are usually characterised by low winds speeds (i.e. calm conditions) and a stable atmosphere, which typically occur during the evenings and overnight.

7.4.3.1 Sensitivity Analysis

The method used for estimating the odour emission rate from goats (ie pheromone rather than manure) included a sensitivity analysis. In this analysis the CALPUFF model has been used to estimate the maximum allowable goat odour emission rate that would maintain compliance with the NSW EPA odour criterion at the nearest sensitive receptors. This analysis has been performed as there are very few acceptable examples of goat odour emission rates measured under Australian conditions available in the literature.

The cumulative impact of all sources excluding goat odour predicted at the most impacted receptor location was 1.2 OU at Receptor 1. The maximum allowable incremental impact from goat odour is therefore the difference between the odour criterion of 6 OU and the odour concentration due to other sources at Receptor 1 of 1.2 OU, which is 4.8 OU. This gives a maximum acceptable contribution from goat odour of 4.8 OU at receptor 1 (99th percentile ground level concentration).

The holding pens were modelled with a unit emission rate (ie 1 OU.m³/m²/s) which gave a maximum predicted 99th percentile ground level concentration of odour of 0.07 OU at receptor 1. As the maximum downwind concentration is proportional to the emission rate, scaling these results gives a maximum allowable emission rate for goat odour of 68.7 OU.m³/m²/s for the area source representing the holding pens.

This maximum allowable emission rate for goat odour can be compared to goat odour emission rates reported in the literature, as a sensitivity test, to determine whether there is potential to give rise to nuisance impacts.

The odour emission rate reported by one study from a mix of goats was $6.6 \text{ OU}\cdot\text{m}^3/\text{m}^2/\text{s}$ (Ektimo, 2015). This emission rate is well below the maximum allowable odour emission rate of $68.7 \text{ OU}\cdot\text{m}^3/\text{m}^2/\text{s}$. However, an emission rate per area doesn't take into account differences in the density of goats present during the Ektimo sampling and the density of goats for the proposed Project. It follows that the more goats in an area, the higher the odour emission will be. Therefore, it is important to factor in the proposed density of goats when determining the maximum allowable odour emission rate for the proposed facility.

The Ektimo goat odour emission rate of $6.6 \text{ OU}/\text{m}^2/\text{s}$ was based on the results of sampling emissions from 2,100 goats in a $13,260 \text{ m}^2$ shed. At this density of $0.16 \text{ goats}/\text{m}^2$, the odour emission rate becomes $42 \text{ OU}\cdot\text{m}^3/\text{s}/\text{goat}$.

A second study from the Netherlands² quotes an odour emission rate of $18.8 \text{ OU}\cdot\text{m}^3/\text{s}/\text{goat}$. The circumstances under which this odour emission rate was measured is not reported however it provides a counterpoint to the Ektimo odour emission rate and highlights the variability inherent in odour sampling of goats.

The Project proposes a maximum density of 11,000 animals in $9,752 \text{ m}^2$ of pens, which is $1.1 \text{ animals}/\text{m}^2$. Taking this into account, the maximum allowable odour emission rate of $68.7 \text{ OU}\cdot\text{m}^3/\text{m}^2/\text{s}$ would become $61.3 \text{ OU}\cdot\text{m}^3/\text{s}/\text{goat}$.

Based on the goat odour emission rates presented by Ektimo and reported in the Netherlands of $42 \text{ OU}\cdot\text{m}^3/\text{s}/\text{goat}$ and $18.8 \text{ OU}\cdot\text{m}^3/\text{s}/\text{goat}$ respectively, it is unlikely that the maximum allowable emission rate for the Project site of $61.3 \text{ OU}\cdot\text{m}^3/\text{s}/\text{goat}$ would be exceeded. Therefore, it is concluded that the odour criterion at the sensitive receptors would be met by the Project.

This analysis provides a degree of certainty that the permitted range of odour emission rates possible from goats is both comparable with previously measured odour emission rates, and will not lead to adverse impacts at the nearest sensitive receptors.

The following conservative assumptions used in the modelling and the sensitivity analysis should also be noted:

1. The maximum number of animals in the holding yards of the Project site has been considered to be 11,000 goats. However, the proposed facility will hold a mixture of sheep, lambs and goats on any given day. It has been established that it's unlikely that more than 7,000 goats will be on-site at any one time.
2. The strong odour associated with goats is mainly due to rutting male goats. In wild goat populations there are a higher proportion of female goats in the herd. However, it is recognised that there will be minimal control over the mix of goats delivered to the Project site.
3. The odour emission rates utilised in **Table 17** have been conservatively selected. In most cases, the maximum available emission rate has been selected from a database of literature values for similar sources and operations. Conservative odour emission rates for these sources add to the total ground level concentrations of odour reaching receptor 1 and hence, a smaller allowable contribution from goat odour was calculated. The conservatism of the assessment is compounded by the maximum worst case emission rates used allowing a minimum reserve for goat odour emissions.

² http://www.olores.org/index.php?option=com_content&view=article&id=194&lang=en. Last accessed 04/02/16.

8 CONCLUSION

SLR Consulting Australia Pty Ltd was commissioned by CAPRA Developments Pty Limited to perform a Construction and Operational Air Quality Impact Assessment (including odour) for the proposed development of a small stock abattoir located approximately 14 km north of Bourke in northwestern New South Wales.

This study will inform the overall Environmental Impact Statement required to be submitted to the NSW Department of Planning and Environment. The specific requirements of this study are outlined within the Secretary's Environmental Assessment Requirements as issued for State Significant Development 7268, issued on 29 October 2015.

The objective of this air quality impact assessment was to define the sources of emissions from the proposed construction and operation of the Project and assess the impacts against applicable air quality criteria to determine the requirement for further mitigation and control, and to identify any residual impacts.

The potential impacts on local air quality from construction activities were assessed qualitatively, using the *IAQM Guidance on the Assessment of Dust from Demolition and Construction* developed in the United Kingdom by the Institute of Air Quality Management.

The qualitative assessment of construction impacts considered, via a screening assessment, the likely dust emissions from the construction of the abattoir and associated infrastructure. Overall, the risk of air quality impacts from earthworks, construction of infrastructure, and track-out of dust were determined to be *negligible* across the Project Site given the distance between the Project site and the nearest sensitive receptors. Mitigation and management measures will still be applied during the works and therefore it is considered that there is no potential for adverse impact due to dust emissions generated during the construction phase of the Project.

The potential impacts on local air quality from operational activities were assessed quantitatively using regulatory-approved atmospheric dispersion modelling methodologies. The operational phase assessment addressed the potential impacts on local air quality of emissions of nitrogen dioxide (NO₂), particulate matter less than 10µm in diameter (PM₁₀), and odour from the operation of the proposed Bourke small stock abattoir. The pollutant emission rates and source parameters used in the modelling were based on a combination of site-specific information and data from air quality assessments carried out for similar facilities.

The ground level pollutant concentrations predicted at the nearest sensitive receptors met their respective guidelines for the appropriate averaging periods, with and without the inclusion of background air quality concentrations. Provided the abattoir is well managed, it is therefore concluded from these results that it will be able to operate in compliance with all relevant ambient air quality standards.

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MODEL SELECTION

MODEL SELECTION

There are several notable dispersion model options available for use in NSW. They include:

- AUSPLUME;
- AERMOD; and
- CALPUFF.

AUSPLUME

AUSPLUME (Lorimer, 1986) is a steady state Gaussian plume dispersion model, whose mathematical basis derives from the ISC model (Bowers, et al., 1979), which is capable of simulating the effects of multiple sources, including stacks, volume sources and area sources. Their effects can be integrated over a long time period (>1 year), or evaluated for short-term maximum impacts. Gravitational effects (settling) can be accounted for in particle emissions by including information on particle characteristics. The terrain and gravitational options are not highly sophisticated, but for general purposes are considered to be useful and adequate.

Most State regulatory authorities in Australia recognise AUSPLUME Version 6.0 (v6.0) or later as an acceptable dispersion model for general use (EPA Victoria, 2001) (NSW OEH, 2005) (SA EPA, 2006). In January 2014, the EPA Victoria phased out AUSPLUME as the regulatory model in favour of AERMOD. AUSPLUME is not normally recommended for use in the following applications, noting that this is not an exhaustive list:

- Complex terrain where the height of any receptor exceeds the lowest release height (NSW OEH, 2005).
- Dispersion modelling beyond a distance of 10 kilometres.
- Where sensitive receptors are located at a distance from the source that is greater than the minimum distance travelled by the plume in one hour (under conditions critical to compliance).

AUSPLUME, like all Gaussian models, is limited as a dispersion model in the manner in which it operates, which is to:

- predict ensemble-average concentrations but not the transient peaks caused by downdrafts in thermal convection eddies
- ignore or only partly account for horizontal and vertical variation in turbulence, wind speed and wind direction within the boundary layer
- assume quasi-steady state conditions. This precludes simulation of events such as inversion breakup fumigation
- ignore longitudinal diffusion (parallel to the plume axis), which restricts applications to wind speeds above about 0.5 m/s
- use empirical dispersion parameters σ_y and σ_z that are difficult to determine experimentally beyond about 10 km from a source and become meaningless at distances sufficiently large for advection effects to dominate over diffusion (which may be only a kilometre in complex terrain)
- be unsuccessful in its ability to precisely parameterise the complex flow in the wake of buildings or other obstacles.

MODEL SELECTION

AERMOD

AERMOD stands for the AERMIC Dispersion Model. It was designed by the AERMIC Committee (the American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee) to treat elevated and surface emission sources in terrain that is simple or complex (Perry & Cimorelli, 2005).

AERMOD has been built on the framework of the Industrial Source Complex (ISC3) model and retains the steady-state limitation of ISC3. However, its treatment of dispersion in the presence of complex terrain improves on that used in ISC3 and it contains advanced algorithms to describe turbulent mixing processes in both convective and stably stratified conditions. AERMOD also offers new and potentially improved algorithms for plume rise and buoyancy, as well as the computation of vertical profiles of wind, turbulence and temperature.

In November 2006 AERMOD replaced ISC3 model as the USEPA's regulatory model for near-field applications (less than 50 km) for simple and complex terrain (US EPA, 2008). Compared to ISC and AUSPLUME, AERMOD represents an advanced new-generation model which requires additional meteorological and land-use inputs to provide more refined predictions. However, given that AERMOD is essentially a more refined version of the ISC dispersion model the same limitations listed for AUSPLUME are likely to apply to AERMOD.

CALPUFF

CALPUFF (California Puff model) is a multi-layer, multi-species non-steady state puff dispersion model that can simulate the effects of time- and space-varying meteorological conditions on pollutant transport, transformation and removal (Scire, et al., 2000). CALPUFF is a highly versatile and widely-used model which can be run in three-dimensional or two-dimensional mode with respect to meteorology. The three-dimensional mode allows spatially varying wind fields, for example, to be incorporated: this can be important in coastal regions with seabreeze effects. CALPUFF also allows plumes to be tracked through time as they are transported by regional winds: in coastal regions recirculation of pollutants due to seabreeze and landbreeze cycles can also be important.

CALPUFF contains algorithms for near-source effects such as building downwash, partial plume penetration, sub-grid scale interactions as well as effects such as pollutant removal, chemical transformation, vertical wind shear, a Probability Distribution Function for dispersion in the convective boundary layer and coastal interaction effects (e.g. sea-breeze recirculation and fumigation within the Thermal Internal Boundary Layer).

Meteorological data used to drive CALPUFF are processed by the CALMET meteorological pre-processor (Scire, et al., 2000). CALMET includes a wind field generator containing objective analysis and parameterised treatments of slope flows, terrain effects and terrain blocking effects. The pre-processor produces fields of wind components, air temperature, relative humidity, mixing height and other micro-meteorological variables to produce the three-dimensional meteorological fields that are used in CALPUFF. CALMET uses measured and/or modelled meteorological inputs in combination with land use and geophysical information for the modelling domain to predict gridded meteorological fields for the region of interest.

CALPUFF is an USEPA regulatory model (US EPA, 2008) and is widely used in Australia.

MODEL SELECTION

Site Specific Factors affecting Model Selection

The dispersion algorithms used by the models determines how the model simulates the dispersion of a plume. The Gaussian models assume that the average concentration distribution of the plume is based on a Gaussian distribution. However, at any particular instant, the actual concentration may be very different. In addition, the steady state nature implies that these models can't simulate the effects of time- and space-varying meteorological conditions. Non-steady state models can simulate the effects of time- and space-varying meteorological conditions on pollutant transport. AUSPLUME and AERMOD are steady-state Gaussian models whereas CALPUFF is a non-steady state puff model.

Another key modelling consideration is the specification of the Gaussian dispersion coefficients (σ_y and σ_z). These describe the horizontal and vertical dispersion parameters used to define the rate of turbulent diffusion of contaminants in the plume in the horizontal and vertical directions. AUSPLUME uses Pasquill-Gifford stability categories, whereas AERMOD and CALPUFF favour the more complex, Monin-Obukhov similarity theory.

An accurate characterisation of the sources of emission and their effective emission rates is crucial for adequate quantification of the pollutant concentrations. Sources described as volume sources have an initial horizontal and vertical spread. Area sources have an emission rate applied across the surface of the area (in $\text{g/m}^2/\text{s}$). This site has a high proportion of sources described as either area or volume sources. AUSPLUME does not adequately describe emissions from area sources and it is recommended that a volume source approximation be used to model area sources. Plume meander has not been implemented for area sources in AERMOD. As a result, concentration predictions for area sources may be overestimated under very light wind conditions. It is recommended that a volume source approximation be used to model area sources in AERMOD. However, CALPUFF uses a specialised algorithm to simulate concentrations within and downwind of area sources.

The dispersion algorithms, the treatment of turbulent diffusion, and the characterisation of sources inherent to CALPUFF are more sophisticated and more accurately simulate the real world dispersion of plumes. With regard to odour dispersion modelling in particular, AUSPLUME has pronounced limitations under the conditions often most critical for the prediction of maximum impacts, i.e., very light wind, stable conditions. Therefore, the CALPUFF dispersion model was selected for use in this assessment, as it is most critically able to better account for the behaviour of plumes under light wind, stable conditions.

CONSTRUCTION PHASE RISK ASSESSMENT METHODOLOGY

RISK ASSESSMENT METHODOLOGY**Overview**

The methodology adopted for this risk-based assessment has been adapted from UK guidance presented in the Institute of Air Quality Management (IAQM) document, *Guidance on the assessment of dust from demolition and construction* (February 2014).

The IAQM method uses a four step process for assessing dust impacts and impacts to human health from PM₁₀ concentrations from construction activities:

Step 1: Screening based on distance to nearest receptor.

Step 2: Assess risk of effects from activities based on:

- the scale and nature of the works, which determines the potential emission magnitude; and
- the residual sensitivity of the area.

Step 3: Determine site-specific mitigation for remaining activities with greater than negligible effects.

Step 4: Assess significance of remaining activities after mitigation has been considered.

The assessor should apply a pragmatic approach to the assessment. There may be occasions where the examples provided are subject to exclusions.

Methodology**Step 1**

The Step 1 screening criteria provided by the IAQM guidance suggests screening out any assessment of impacts from construction activities where sensitive receptors are located more than:

- 350 m from the boundary of the site
- 50 m from the route used by construction vehicles on public roads more than 500 m from the site entrance.

This step is noted as having deliberately been chosen to be conservative, and will require assessment for applicability in all cases.

Step 2a

The Step 2a of the assessment provides “emission magnitudes” for four activities; demolition, earthworks, construction, and trackout. “Magnitude” describes the anticipated scale of proposed works and consequently, the potential scale of the predicted environmental change and the likelihood of the impact resulting in a change to existing (baseline) conditions. The magnitudes are: Large; Medium; or Small. Suggested definitions for each category provided in **Table A** for each activity.

CONSTRUCTION PHASE RISK ASSESSMENT METHODOLOGY

Table A Scale of Activity Considerations

Scale of Activity	Demolition	Earthworks	Construction	Trackout ^{1, 2}
Large	Total building volume of >50,000 m ³	Total site area > 10,000 m ²	Total building volume > 100,000 m ³	Unpaved road length > 100 m
	Demolition activities > 20 m above ground	>10 heavy earth moving vehicles active at any one time		> 50 HRV outward movements (maximum one-way movements in one day)
	On-site crushing and screening	Total material moved >100,000 tonnes	On-site concrete batching or sandblasting.	
	Potentially dusty construction materials.	Potentially dusty soil type (e.g. clay)		Potentially dusty surface material (e.g. high clay content)
		Earthworks carried out during seasons typically associated with high wind speed components.		
Medium	Total building volume between 20,000 m ³ and 50,000 m ³	Total site area 2,500 m ² - 10,000 m ²	Total building volume 25,000 m ³ – 100,000 m ³	Unpaved road length 50 m -100 m
	Demolition activities 10 - 20 m above ground	5 – 10 heavy earth moving vehicles active at any one time	On-site concrete batching	10 – 50 HRV outward movements (maximum one-way movements in one day)
	Potentially dusty construction materials.	Total material moved 20,000 T – 100,000 T	Potentially dusty construction materials used.	Moderately dusty surface material (e.g. medium clay content)
Small	Total building volume < 20,000 m ³	Total site area < 2,500 m ²	Total building volume < 25,000 m ³	Unpaved road length < 50 m
	Demolition activities < 10 m above ground	< 5 heavy earth moving vehicles active at any one time		< 10 HRV outward movements (maximum one-way movements in one day)
	Demolition performed during wetter months	Total material moved < 20,000 T		
	Construction material with low potential for dust release (e.g. primarily metal cladding or timber).	Soil type with large grain size (e.g. sand)	Construction material with low potential for dust release (e.g. metal cladding or timber).	Surface material with low potential for dust release (e.g. sand)
		Earthworks carried out during wetter months.		

Source: IAQM 2014

1. For vehicles that leave the site after moving over unpaved ground, where they will accumulate mud and dirt that can be tracked out onto public roads / highway. HRV = Heavy Rigid Vehicle greater than 3.5 T truck.
2. Scale of trackout activities should be considered as negligible if receptor is located > 50 m from the road.

Step 2b

Step 2b of the assessment allows the residual sensitivity of the area to be defined and addresses different potential effects on the population and property, and human health. The sensitivity of the area takes into account:

- The specific sensitivities of receptors in the area.
- The proximity and number of those receptors.
- Site specific factors, such as whether there are natural shelters, such as trees, to reduce the risk of wind-blown dust.

CONSTRUCTION PHASE RISK ASSESSMENT METHODOLOGY

- In the case of impacts to human health, the local background concentration of PM₁₀ is considered.

Receptors may be classified as having high, medium or low sensitivity to dust deposition, or PM₁₀ concentrations. Exposure to dust deposition may lead to nuisance impacts and exposure to PM₁₀ has the potential to have impacts on human health.

Table B and **Table C** show how the residual sensitivity of an area may be determined considering the number of receptors and the distance of those receptors from the construction site for nuisance dust and human health impacts. When using these tables it should be noted that distances are to the source and so a different area may be affected by trackout than by on-site works.

Site specific circumstances should be taken into account in all cases so that the sensitivity that most adequately reflects the nature of the receptors is applied. Additional factors to consider when determining the residual sensitivity of the receptor include:

- Any history of dust generating activities in the area
- The likelihood of concurrent dust generating activities on nearby sites
- Any pre-existing screening between the source and the receptors
- Any conclusions drawn from analysing local meteorological data, and, if relevant, the season during which the works will take place
- Any conclusions drawn from local topography
- Duration of the potential impact, as a receptor may become more sensitive over time.

RISK ASSESSMENT METHODOLOGY

Table B Residual Sensitivity of the Area to Dust Deposition Impacts

Land Use Receptor Sensitivity		No. of Receptors	Residual Receptor Sensitivity			
			Distance from Source (m)			
			<20	<50	<100	<350
High	Receptors with high land use sensitivity to air pollution include: hospitals, retirement homes, painting and furnishing, hi-tech industries, food processing, schools, high density residential areas, food retailers, glasshouses and nurseries, horticultural land and offices, museums, car showrooms.	>100	High	High	Medium	Low
	Users would reasonably be expected to be present continuously (or at least regularly) for extended periods at the property.	10–100	High	Medium	Low	Low
	- Users can reasonably expect a high level of amenity. - The appearance, aesthetics or value of a receptor would be diminished by soiling. - There is substantial risk that the impacts will generate nuisance complaints, resulting in regulatory action.	1–10	Medium	Low	Low	Low
Medium	- Receptors with medium land use sensitivity to air pollution include: farms, outdoor storage, light and heavy industry, parks, places of work. - Users wouldn't reasonably be expected to be present at the property continuously or regularly for extended periods as part of the normal pattern of use of the land. - Users would expect to enjoy a reasonable level of amenity, but would not expect to enjoy the same level of amenity as in their home. - The appearance, aesthetics or value of a receptor could be diminished by dust deposition. - There is moderate to slight risk that the impacts will generate nuisance complaints, resulting in regulatory action.	>1	Medium	Low	Low	Low
Low	- All other air quality sensitive receptors not identified above - There is transient exposure where the receptors would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land. - The population is accustomed to transient changes in dust deposition due to natural occurrences and does not have high expectations regarding dust deposition in the area. - Property would not reasonably be expected to be diminished in appearance, aesthetics or value by dust deposition. - Negligible risk that the impacts will generate nuisance complaints resulting in regulatory action.	>1	Low	Low	Low	Low

Source: IAQM 2014

1. Estimate the total number of receptors within the stated distance. Only the highest level of area sensitivity from the table needs to be considered. For example, if there are 7 high sensitivity receptors <20 m of the source and 95 high sensitivity receptors between 20 and 50 m, then the total number of receptors <50 m is 102. The residual sensitivity in this case would be high.
2. See **Table A** for 'Trackout' activities.

RISK ASSESSMENT METHODOLOGY

Table C Residual Sensitivity of the Area to Human Health Impacts

Land Use Receptor Sensitivity		Annual Mean 24-hour PM ₁₀ Concentration	No. of Receptors	Residual Receptor Sensitivity				
				Distance from Source (m)				
				<20	<50	<100	<200	<350
High	- Locations where members of the public are exposed over a time period relevant to the air quality objective for PM₁₀ (i.e. where individuals may be exposed for eight hours or more) - Indicative examples include residential properties, hospitals, schools and retirement homes.	>90% of criterion (>45 µg/m³)	>100	High	High	High	Medium	Low
			10-100	High	High	Medium	Low	Low
			1-10	High	Medium	Low	Low	Low
		75 – 90% of criterion (37 µg/m³ to 45 µg/m³)	>100	High	High	Low	Low	Low
			10-100	High	Medium	Low	Low	Low
			1-10	High	Medium	Low	Low	Low
		50 – 75% of criterion (25 µg/m³ to 37 µg/m³)	>100	High	Medium	Low	Low	Low
			10-100	High	Medium	Low	Low	Low
			1-10	Medium	Low	Low	Low	Low
		<50% of criterion (<25 µg/m³)	>100	Medium	Low	Low	Low	Low
			10-100	Low	Low	Low	Low	Low
			1-10	Low	Low	Low	Low	Low
Medium	- Locations where the exposed population are workers and exposure is over a time period relevant to the air quality objective for PM₁₀ (i.e. where individuals may be exposed for eight hours or more) - Indicative examples include offices and shops but don't include workers.	-	>10	High	Medium	Low	Low	Low
		-	1-10	Medium	Low	Low	Low	Low
Low	- Locations where human exposure is transient. - Indicative examples include public footpaths, playing fields, parks and shopping streets.	-	>1	Low	Low	Low	Low	Low

Source: IAQM 2014

1. Estimate the total number of receptors within the stated distance. Only the highest level of area sensitivity from the table needs to be considered. For example, if there are 7 high sensitivity receptors <20 m of the source and 95 high sensitivity receptors between 20 and 50 m, then the total number of receptors <50 m is 102. If the annual mean 24-hour PM₁₀ objective is between 75% and 90% of the criterion value, the sensitivity in this case would be high.
2. In the case of high land use sensitivity receptors with high occupancy (i.e. schools, hospitals) approximate the number of people likely to be present or assume > 100 people. In the case of residential dwellings, just include the number of properties.
3. See **Table A** for 'Trackout' related definitions and receptor distances.

CONSTRUCTION PHASE RISK ASSESSMENT METHODOLOGY

Step 2c

The dust emission magnitude from Step 2a and the receptor sensitivity from Step 2b are then applied to the matrices shown below (Matrix 1 – 4) to determine the risk category with no mitigation applied.

Matrix 1 Risk of Impacts - Demolition

Sensitivity of Area	Scale of Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

Matrix 2 Risk of Impacts - Earthworks

Sensitivity of Area	Scale of Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Matrix 3 Risk of Impacts - Construction

Sensitivity of Area	Scale of Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Matrix 4 Risk of Impacts - Trackout

Sensitivity of Area	Scale of Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

Step 3

Once the risk categories are determined for each of the relevant activities, site-specific mitigation measures are identified based on whether the site is a low, medium or high risk site.

Step 4

The residual impact can be determined after mitigation has been considered.

CONSTRUCTION PHASE RISK ASSESSMENT METHODOLOGY

Matrix 5 Example Preliminary Risk Rating

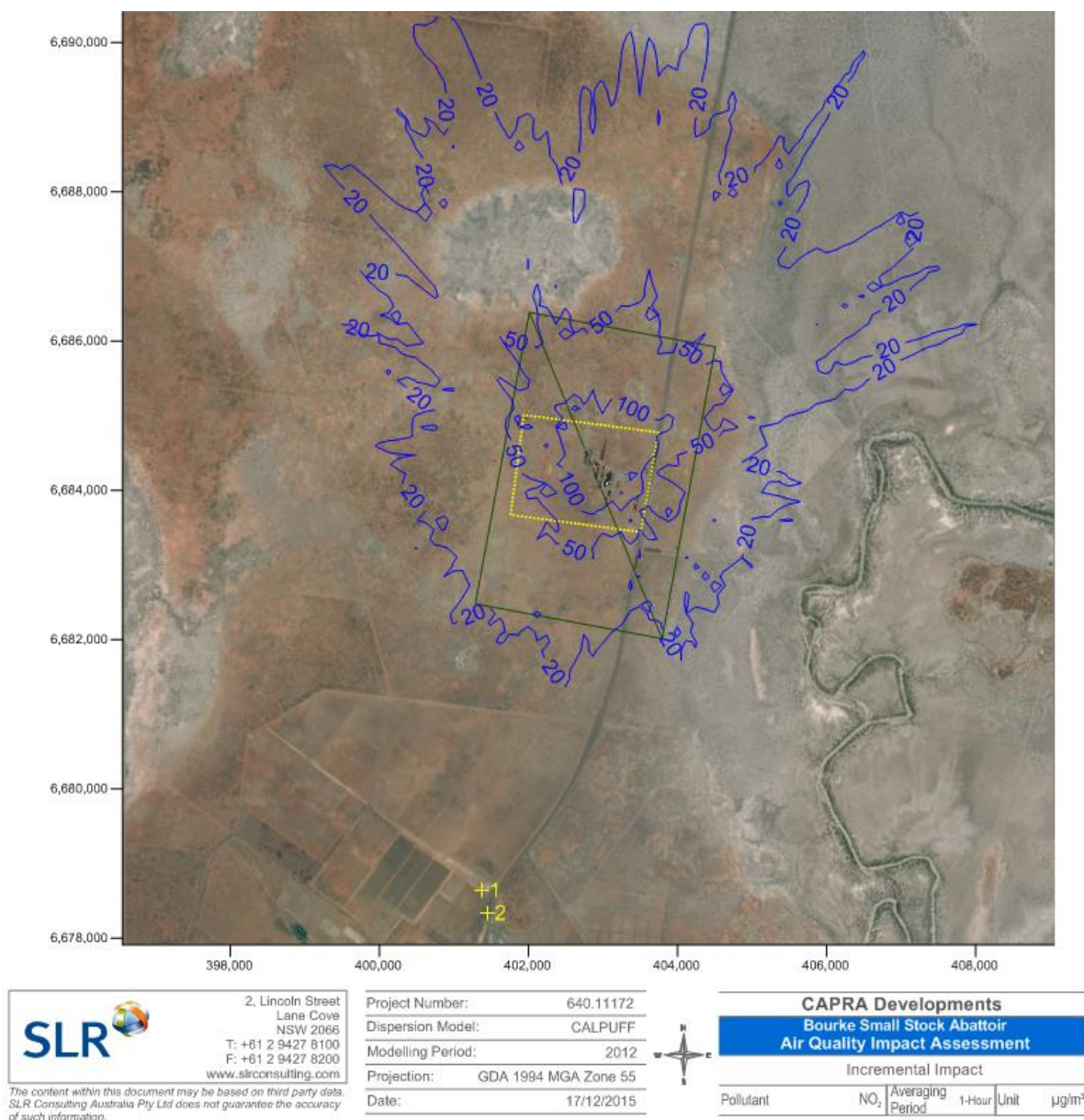
Potential Impact	Preliminary Risk			
	Demolition	Earthworks	Construction	Trackout
Dust Deposition	High	Medium	Low	Low
Human Health	Medium	Medium	Low	Low

Matrix 6 Example Residual Risk Rating

Potential Impact	Residual Risk			
	Demolition	Earthworks	Construction	Trackout
Dust Deposition	Medium	Low	Negligible	Negligible
Human Health	Low	Low	Negligible	Negligible

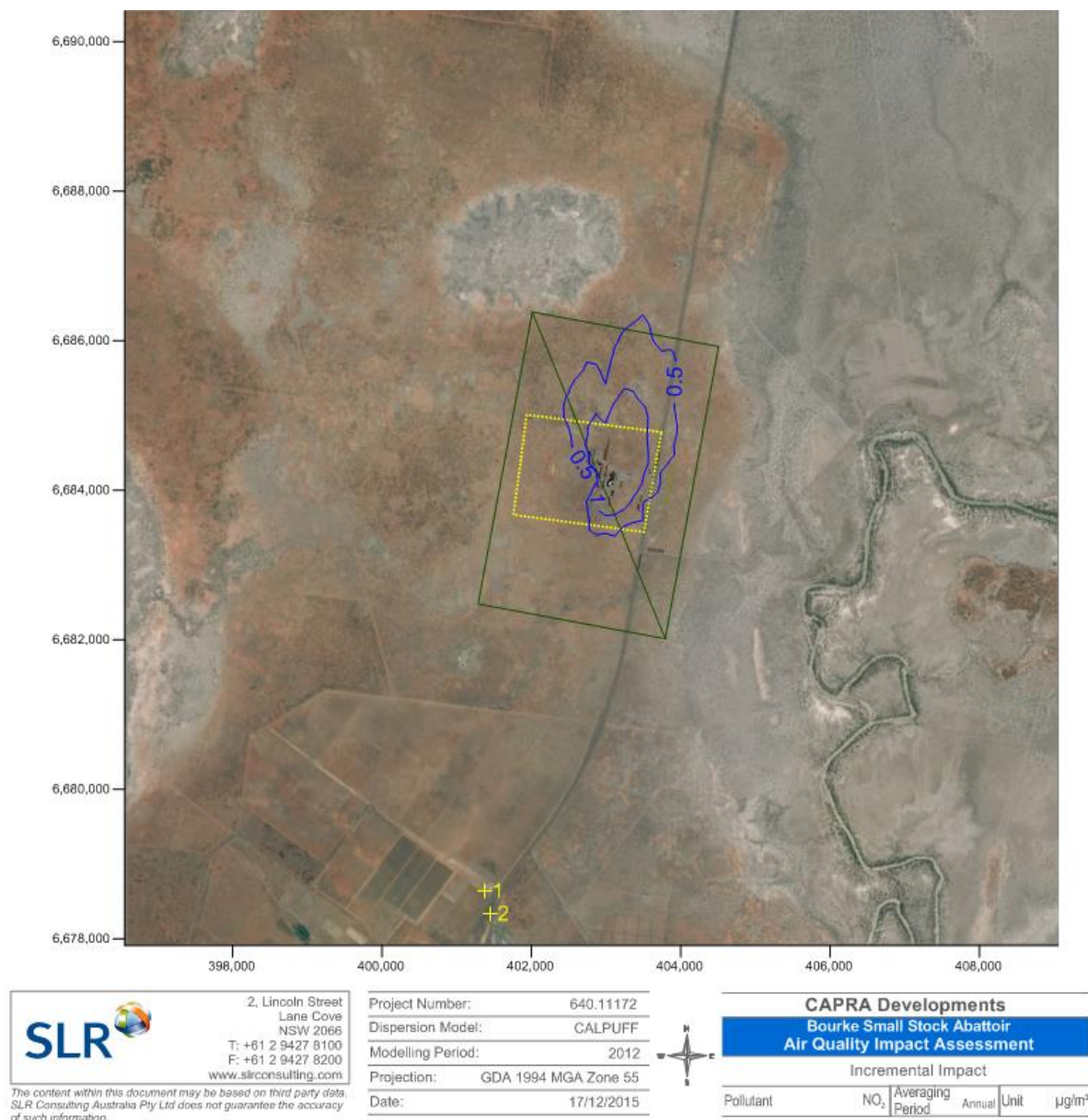
CONCENTRATION CONTOURS

Figure 19 Predicted Maximum 1-hour Average NO₂ Ground Level Concentrations



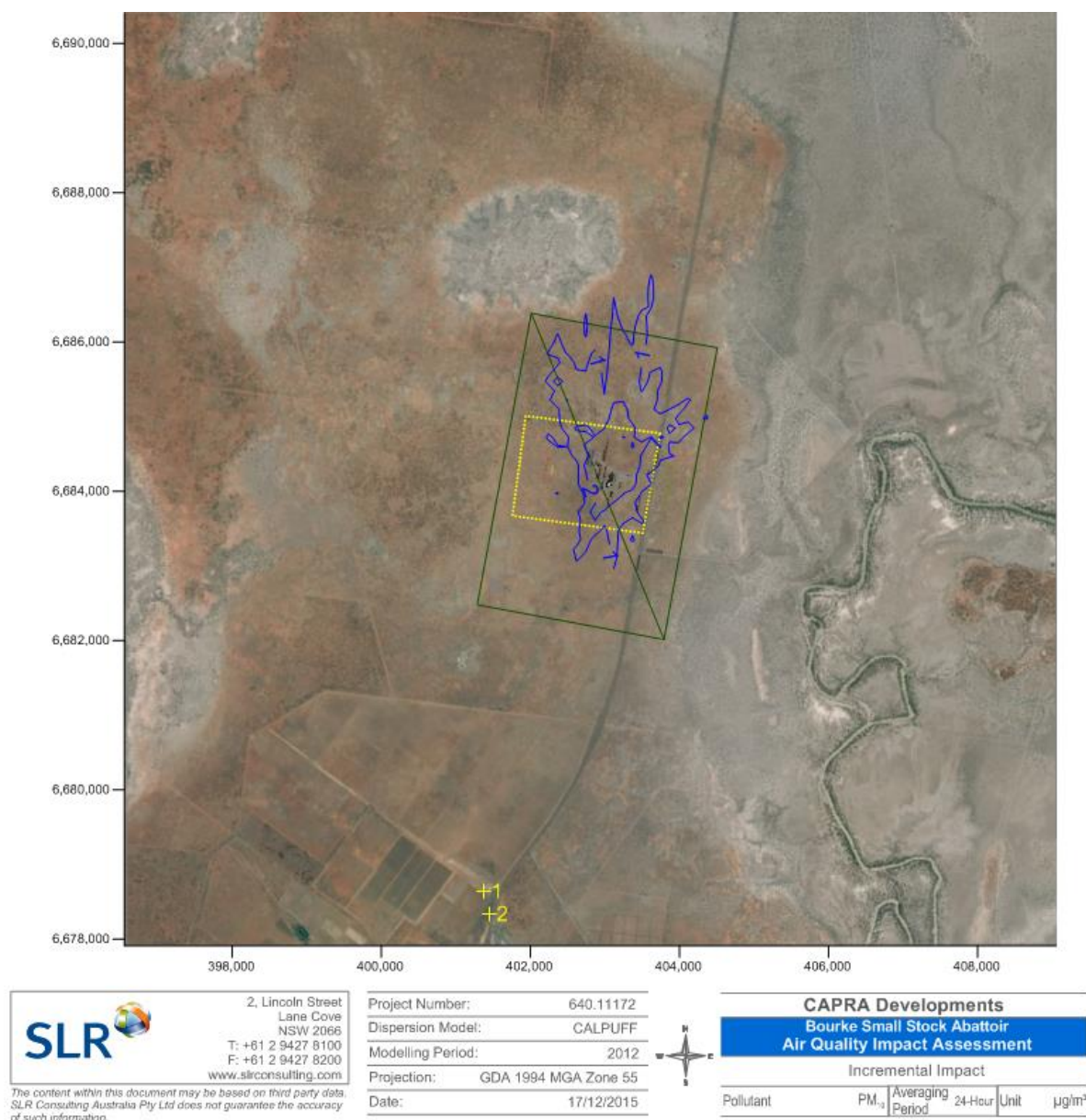
CONCENTRATION CONTOURS

Figure 20 Predicted Annual Average NO₂ Ground Level Concentrations



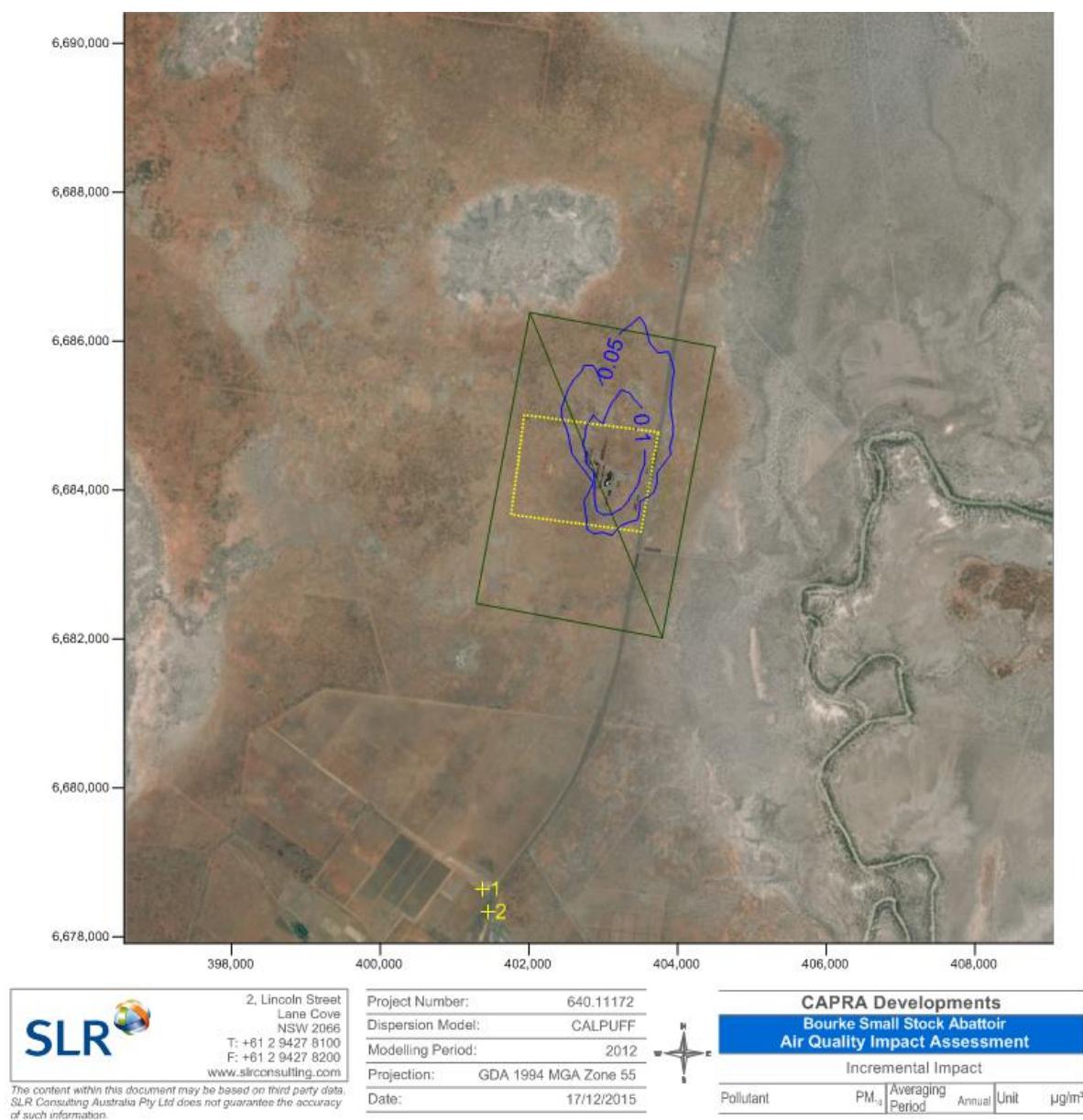
CONCENTRATION CONTOURS

Figure 21 Predicted Maximum 24-hour Average PM₁₀ Ground Level Concentrations



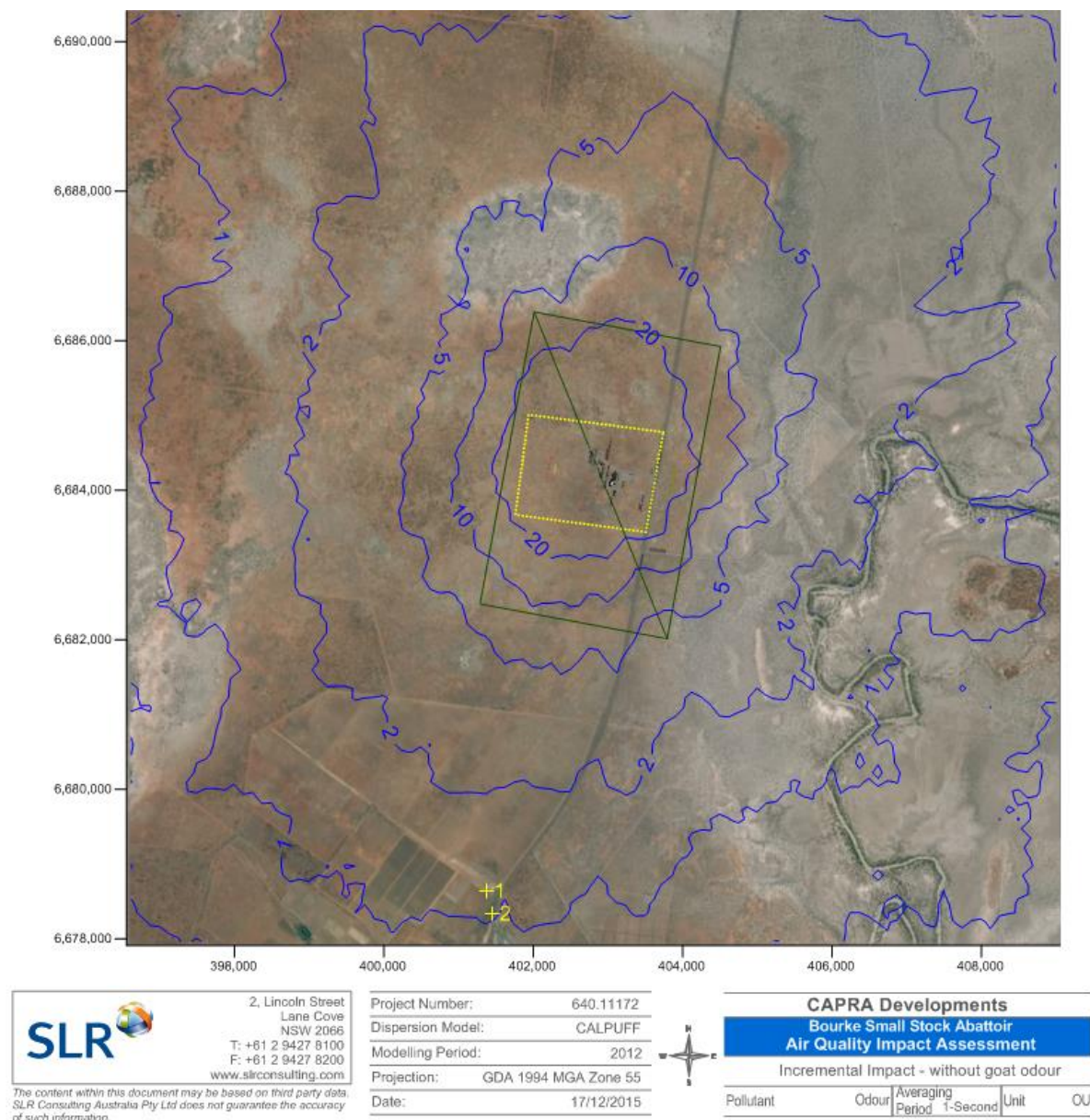
CONCENTRATION CONTOURS

Figure 22 Predicted Annual Average PM₁₀ Ground Level Concentrations



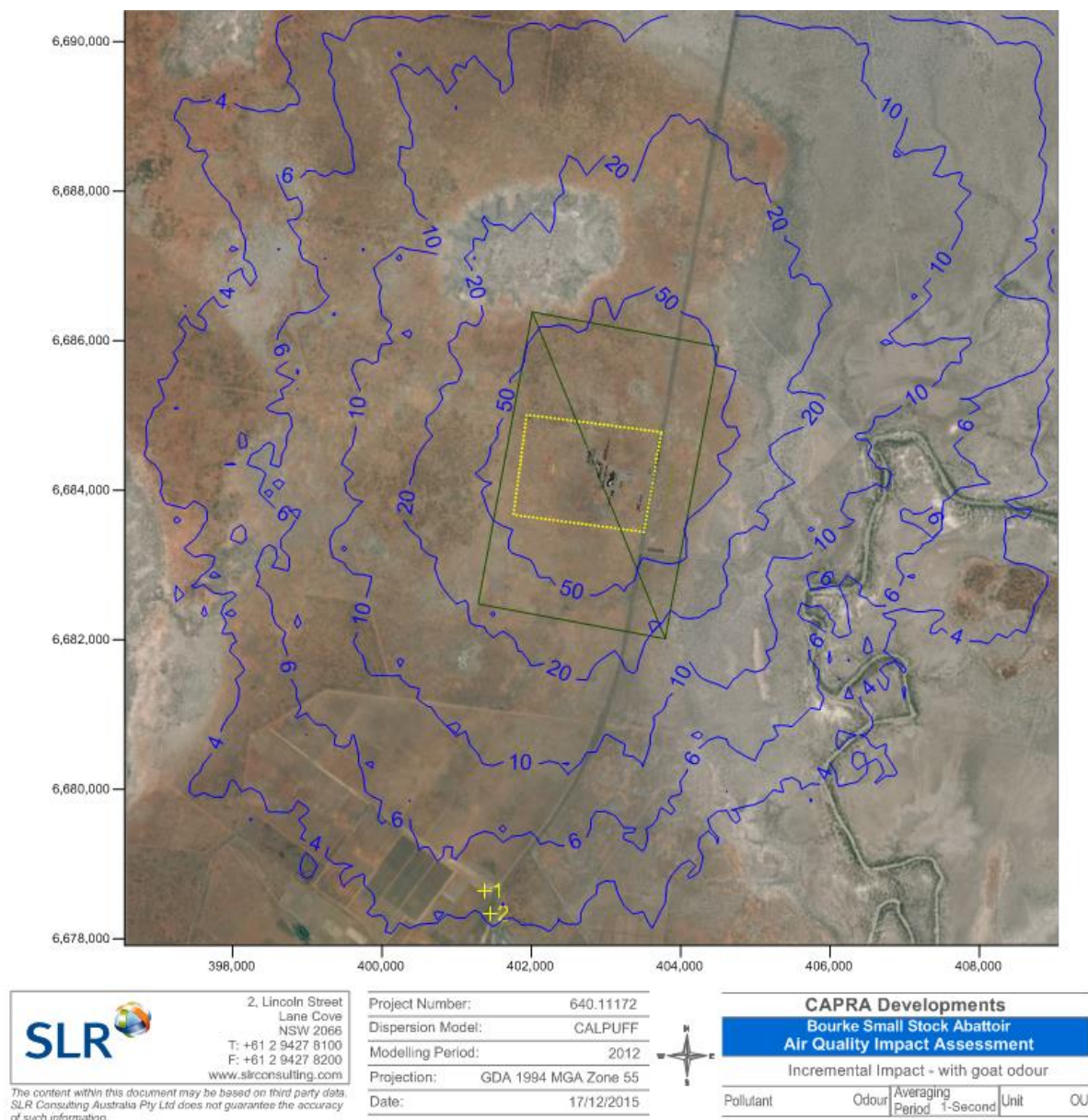
CONCENTRATION CONTOURS

Figure 23 Predicted 1-Second Average Odour Ground Level Concentrations (without goat odour)



CONCENTRATION CONTOURS

Figure 24 Predicted 1-Second Average Odour Ground Level Concentrations (with goat odour)

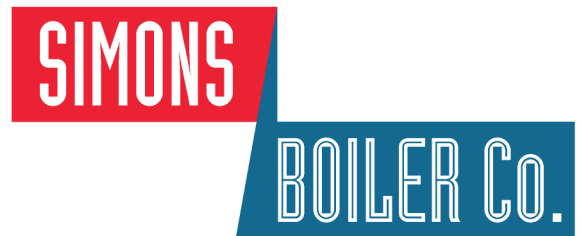


Appendix D

Report Number 640.11172

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BOILER MANUFACTURER'S GUARANTEE



W.SIMONS & SONS (AUST.) PTY. LTD. ABN 73 000 194 892 TRADING AS
SIMONS BOILER CO. AUSTRALIAN FAMILY OWNED COMPANY SINCE 1932

21 July 2014

Thermal Air
Orange

Subj GAS FIRED STEAM BOILER, 2 x 1000 KW

Dear Jim,

Further to your enquiry, we take pleasure in submitting our quote for the above as follows:

AUSTRALIAN MADE GAS FIRED STEAM BOILER (UNATTENDED OPERATION)

The offer is for the supply of an unattended water tube steam boiler fitted with quality valves, fittings and mounts and factory tested to full MCR prior to despatch from factory, then the boilers being prepared for shipping.

The boiler design is a fully welded 3 pass design, the tube arrangement providing for rapid natural circulation thus minimizing thermal shock or stress during start-up. Each boiler vessel has a design pressure of 1,034kPa, with the boilers being fitted out to suit the required operating pressure as specified .

The vertical design of the water tubes minimizes the likelihood of the heating surface being contaminated by settling sludge: this does not eliminate the need for manual blowdown as the boiler water must meet ISI2392-1982 requirements.

The boiler vessel on completion is finished in a high temperature black corrosion inhibitor, then lagged in 50mm mineral wool insulation then clad in white colour bond.

The burner fitted to the boiler will be a quality proprietary brand gun type burner, fitted with an AGA approved gas train, and **SIMENS LMV** burner management system. This Burner is of the forced draft type, designed to provide complete combustion within the furnace, maximizing combustion and keeping noise levels to a minimum.

The feed water system comprises of a vertical multistage feed water pumps with monitor. The system has a quality check valve fitted to minimize the likelihood of pump damage due to check valve failure. The feed water pumps are controlled by a solid state level control system with probes being fitted to boiler steam chest.

Head Office: SYDNEY | 755 Botany Road | Rosebery NSW 2018 | Australia | Telephone 61-2 **8338 8660** | Facsimile 61-2 8338 8661
MELBOURNE | 34 Strong Avenue | Thomastown VIC 3074 | Australia | Telephone 61-3 9462 6700 | Facsimile 61-3 9462 6711
Email simons@simonsboiler.com.au | Website www.simonsboiler.com.au

ELECTRIC & GAS STEAM BOILERS | COMMERCIAL HOT WATER | COMMERCIAL SOLAR | WARM WATER SYSTEMS | STEAM HUMIDIFIERS

GENERAL SPECIFICATION OF BOILER

Boiler Model Number	Simons 100 VWT
Type of Boiler	Water Tube Fully Welded Configuration
Capacity	1000 kW
Evaporation F&A 100C	1547 kg/hr,
Fuel Input	Natural Gas 4500 mj/hr,
Design Pressure	1050kPa
Operating Pressure	1000 kPa
Combustion Efficiency	Nominal 82%, 80% Guaranteed
Burner Type	Fully Automatic , Modulating
Gas Supply	5 - 7 kpa

All three boilers fitted with the following:

- Ecoflam or equivalent packaged **modulating** gun burner .
- AGA approved pilot gas solenoids
- AGA approved main gas solenoids
- Gas appliance regulator
- High voltage ignition transformer
- Air pressure proving switch
- Flame rod or uv cell
- SIEMENS SCADA CAPABLE BURNER MANAGEMENT SYSTEM
- Baileys safety valve with stainless trim (2)
- Main stream valve bronze globe valve with stainless trim.
- Manual Blowdown valve
- Self Check flame surveillance system
- Self Check water control system
- Phase fail protection
- Timer Based Auto Blowdown control
- Feed water valve
- Stainless steel trimmed type feedwater check valve

- Klinger 20mm type AB12 water level gauge glass mount
- Fantini stainless bellows steam pressure switch
- Pressure gauge 100mm back flange bottom entry with stainless case.
- Electrical control panel fitted with:
 - Circuit breakers for system isolation
 - Mains isolator
 - G E contactors and indicators
 - Omron relays
 - Omron level controls relays
 - Audible alarm
 - Microammeter for flame signal strength
 - Feed water pumps(1W + 1S) vertical multistage type
- Ladder, access way & platform

Yours sincerely
SIMONS BOILER CO

TAPASH CHOWDHURY
ENGG MANAGER